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HANDBOOK OF OPERATING INSTRUCTIONS

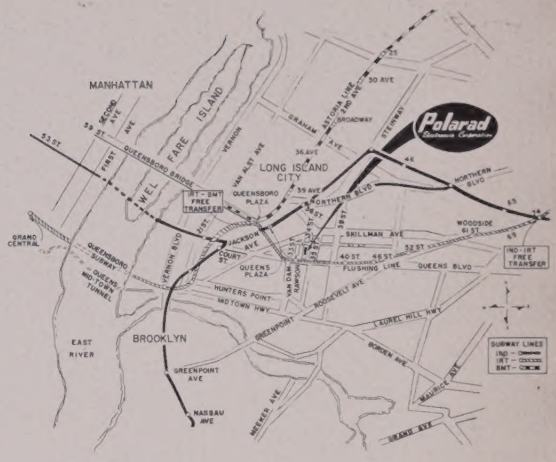
Part II

HANDBOOK OF INSTRUCTIONS

for

MICROWAVE FIELD INTENSITY METER
MODEL FIM

POLARAD ELECTRONICS CORPORATION, 43-20 34th STREET, LONG ISLAND CITY 1, N.Y.



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POLARAD ELECTRONICS CORPORATION
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LONG ISLAND CITY 1, NEW YORK

Part II

HANDBOOK OF INSTRUCTIONS

for

MICROWAVE FIELD INTENSITY METER
MODEL FIM

(SECTIONS E AND F)

Note

This part of the Handbook includes
Sections E and F.

See Part I for Sections A, B, C, and D.

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(for Part II Volume)

NOTE: See Part I Volume for Sections A, B, C, AND D

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SECTION E

MAINTENANCE

45. INTRODUCTION.

To maintain the equipment at peak performance, certain routine checks should be made during equipment operation. Minor defects, such as blown fuses, loose connections, and frayed interconnecting cables, should be corrected immediately. For malfunctioning that is caused by trouble within the interior of the chassis, refer to the trouble shooting chart within this section.

46. EMERGENCY MAINTENANCE.

a. Replacement of Fuses. All fuses are located at the rear of the Power Unit. To remove one of these fuses for inspection or replacement, push the fuseholder in, towards the panel, and rotate the knurled cap 90° counterclockwise. Pull the cap away from the fuseholder mounting. Withdraw the glassbody fuse from the cap and check the fuse for continuity of the fuse element. Two spare fuses are mounted in fuseholders directly above the operating fuses. Refer to table V for fuse ratings.

CAUTION

Never replace a fuse with one of higher rating unless continued operation of the equipment is more important than possible damage. If a fuse burns out immediately after replacement, do not replace it a second time until the cause of malfunctioning has been corrected.

b. Replacement of Electron Tubes. Electron tubes should give many hours of trouble-free operation. Failure of the filament in a tube can usually be detected visually. Other failures may be noted

by improper meter readings. Refer to table IV for location and type of tubes employed in this equipment.

47. SERVICING PROCEDURE.

a. In the normal service life of any piece of equipment, faults and breakdowns will develop. In order that the necessary repairs may be carried out in a reasonably short time, a logical testing routine must be followed. The twofold purpose of any corrective maintenance procedure is, first, the localization of the faulty circuit or stage, and second, the location of the faulty component or part. The trouble must be determined as quickly and as accurately as possible. The maintenance technician should familiarize himself with the circuitry and the component make-up of the equipment prior to the occurrence of trouble. Reference to schematics should be made frequently as an aid to servicing. Also provided as an aid to servicing are a trouble shooting chart and tables of resistance and voltage measurements. (See tables XVII and XXII through XXIV.)

b. Before proceeding with any extensive repair, be reasonably sure that performance of this repair will eliminate the trouble. Do not waste time in needless probing or replacement of parts. When trouble is encountered, be logical and systematic, as outlined in the trouble shooting chart, table XVII.

c. In all repairs and replacements, every attempt should be made to duplicate the original condition of the equipment. Standard replacement parts should be used. Particular care should be taken to run any replacement wiring in the same position and manner as the original wiring. Only rosin-core solder should be employed and only the minimum amount required should be applied. Do not permit excess solder to drop on other components or remain within the chassis.

d. In the event of emergency repairs, where it is impossible to make exact replacement of parts, the same care and workmanship must be taken. The temporarily repaired equipment should be conspicuously marked or tagged to indicate the temporary nature of the repair, and restored to its original condition at the first possible opportunity.

48. LOCALIZING TROUBLE.

a. The first step in correcting any trouble or failure which may occur in the equipment is to isolate the section of the circuit which is causing the trouble. This isolation can best be accomplished by considering the receiver as composed of the basic sections shown in the overall block diagram, figure 36. Trouble ordinarily occurs in only one section at a time, so that it is usually necessary to correct only the one trouble, which may be isolated to one of the following major components:

(1) Any one of the four Tuning Units supplied with the equipment. (See table I.)

(2) Any one of the components of the Monitor Unit. For example, the preamplifier, the i-f amplifier, the audio, video, and metering circuits, the afc-i-f amplifier, or the crystal-controlled local oscillator. (See figure 56.)

(3) The switching circuitry, which is mounted on the rear of the Monitor Unit front panel. (See figure 56.)

(4) Components within the Power Unit. (See figures 54 and 55.)

b. Paragraph 49 gives instructions on inspection procedures. Tables XV and XVI should be referenced as a quick means of localizing

trouble to the interconnecting cables within the Monitor Unit and the Tuning Unit, respectively. Refer to table XVII for the trouble-shooting chart, which lists symptoms, probable causes, and possible remedies, when malfunctioning of the equipment is suspected.

49. INSPECTION PROCEDURES.

a. MONITOR UNIT. To inspect the interior of the Monitor Unit, proceed as follows:

(1) Remove the mounting screws which secure the dust cover to the Monitor Unit (located at the front). Remove the dust cover.

(2) The component parts and subchassis mounted in the Monitor Unit are now visible and accessible for inspection. These are as described below. (See figures 56 through 59.)

(a) The i-f amplifier chassis, at the top left.

(b) The afc-i-f chassis, located at top-center.

(c) The crystal-controlled local oscillator chassis, located at the left-front side.

(d) The video, audio, metering, and detector weighting circuits, located at the right-rear side (as viewed from the front).

(e) The preamplifier chassis, located at the left-rear side.

(f) The switching and control components, mounted on the rear of the front panel.

(g) The rf attenuator chassis, at the top right.

(3) Inspect the interior of the equipment for possible damage during shipment. Check to see that no nuts, washers, or other attaching hardware have become dislodged. Tighten any screws or nuts that serve to retain components to the equipment frame, but do not

tighten screwdriver controls of electrical items, since this action will result in changing the electrical characteristics of the equipment. Search carefully for broken wires and loose connections on the various subchassis. A detailed inspection at this time will save much inconvenience and delay in the long run. Rotate the front panel OUTPUT METER FUNCTION SELECTOR switch to each of its four positions, and check for positive action, without binding. Also rotate the METER SELECTOR INPUT ATTENUATOR and FUNCTION SELECTOR switches to each of its positions, and check for positive action, and the lack of binding. Rotate the six continuously-variable controls (OUTPUT METER ZERO SET, POWER MONITOR ZERO SET, I.F. GAIN, SLIDEBACK, AUDIO GAIN, and AURAL TUNING AID) for smooth operation throughout their rotational range. Check the POWER UNIT ON-OFF toggle switch for positive action in both its ON and OFF positions.

b. TUNING UNIT. Remove the mounting screws that secure the dust cover to the Tuning Unit (located at the front of the unit). Remove the dust cover. The component parts are now visible and accessible for inspection. Rotate the front panel TUNING control and observe the smooth rotation of the engraved dial, and for longitudinal movement of the tuning plungers within the local oscillator and signal calibrator cavities. Check that the rack and pinion assembly, at the left section of the panel (as viewed from the rear of the equipment panel) produces smooth movement of the pick-up loop in the signal calibrator cavity, as the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control is varied throughout its range. Check the FINE and COARSE TUNING controls for smooth action.

c. MONITOR AND TUNING UNITS. Check to make sure that all tubes are firmly seated in their sockets, that tube shields are properly in place, and that all inter-unit cabling connections are firm and secure. Check intercabling between the various subchassis within the Monitor Unit by reference to table XV below.

TABLE XV. INTERCABLING CONNECTIONS, MONITOR UNIT

Cabling Ref. Symbol and Type	Terminating Connectors	Cable Function
W1, RG-55/U Coaxial	P1 and J1[illegible]	Applies the 14[illegible]-mc signal from the preamplifier output (of the Tuning Unit) to the input of the i-f amplifier chassis.
W2, RG-55/U Coaxial	P2 and P9	Applies the 180-mc output signal from the crystal-controlled local oscillator chassis to the mixer stage of the i-f amplifier chassis.
W3, RG-55/U Coaxial	P3 and P6	Applies the 40-mc output signal from the power amplifier stage in the i-f amplifier chassis to the input of the afc-i-f chassis.
W4, RG-55/U Coaxial	P10 and P803	Applies the 120-mc output signal from the crystal-controlled local oscillator chassis to the crystal mixer stage of the preamplifier.
W5, RG-71/U Coaxial	P4 and wiper contact of OUTPUT METER FUNCTION SELECTOR switch S1, section C	Applies the detected agc output signal from the i-f amplifier chassis to the metering circuit, via OUTPUT METER FUNCTION SELECTOR switch S1.

TABLE XV. INTERCABLING CONNECTIONS, MONITOR UNIT (cont'd)

Cabling Ref. Symbol and Type	Terminating Connectors	Cable Functions
W6, RG-71/U Coaxial	P5 and J13, in parallel with terminals 1, 2, and 3 of OUTPUT METER FUNCTION SELECTOR switch S1, section A	Applies the detected video output signal from the i-f amplifier chassis to the audio amplifying circuit, via OUTPUT METER FUNCTION SELECTOR switch S1.
W7, RG-71/U Coaxial	TB-1, mating connector J13 on front panel.	Applies video output signal to front panel connector J13.
Multi-Conductor Cable	P14 and J14	Applies power and control signal from the audio, video, and metering circuits chassis to the i-f amplifier.
Multi-Conductor Cable	P7, mating connector J7 on afc-if chassis.	Applies output error signal from discriminator in afc-i-f chassis to afc amplifier.
Multi-Conductor Cable	P8, mating connector J8, on top of Monitor Unit.	Applies operating power from the audio, video, and metering circuits chassis to the afc-i-f chassis.
Multi-Conductor Cable	P11, mating connector J11, on top of Monitor Unit.	Applies operating power and output of the 1,000 cps audio oscillator from the audio, video, and metering circuits chassis (when energized) to the crystal-controlled local oscillator chassis.
Multi-Conductor Cable	P102, mating connector J102, on top of Monitor Unit.	Applies DC power to the preamplifier.

TABLE XV. INTERCABLING CONNECTIONS, MONITOR UNIT (cont'd)

Cabling Ref. Symbol and Type	Terminating Connectors	Cable Functions
Multi-Conductor Cable	J19, mating connector P19, on right-rear side of Monitor Unit.	Applies operating power to the audio, video, and metering circuits chassis.
W101, RG-9B/U Coaxial	J120 and P120	Applies r-f signal from front panel rf input jack to terminal 1 of r-f switch S106.
W102, UG-57B/U Coaxial	P121 and P122	Applies rf output from rf switch S106 to rf switch S109.
W103, RG-55/U Coaxial	P123 and P124	Applies rf signal from rf switch S109, without attenuation, to rf switch S110 (in 0 db X1 and 20 db X10 positions of S107).
W104, RG-55/U Coaxial	P125 and P126	Applies rf signal from output of rf switch S109 to rf attenuator AT101 (in 40 db X100 position of S107).
W105, RG-55/U Coaxial	P127 and P128	Applies rf signal from output of rf attenuator AT101 to rf switch S110 (in 40 db X100 position of S107).
W106, RG-55/U Coaxial	P129 and P130	Applies rf signal from output of rf switch S109 to rf attenuator AT102 (in 60 db X1,000 position of S107).
W107, RG-55/U Coaxial	P131 and P132	Applies rf signal from output of rf attenuator AT102 to input of attenuator AT103 (in 60 db X1,000 position of S107).

TABLE XV. INTERCABLING CONNECTIONS, MONITOR UNIT (cont'd)

Cabling Ref. Symbol and Type	Terminating Connectors	Cable Function
W108, RG-55/U Coaxial	P133 and P114	Applies rf signal from output of rf attenuator AT103 to rf switch S110 (in 60 db X1,000 position of S107).
W109, RG-55/U Coaxial	P135 and P136	Applies rf signal from output of rf switch S109 to rf attenuator AT104 (in 80 db X10,000 position of S107).
W110, RG-55/U Coaxial	P137 and P150	Applies rf signal from output of attenuator AT104 to input of attenuator AT105 (in 80 db X10,000 position of S107).
W111, RG-55/U Coaxial	P139 and P140	Applies rf signal from output of attenuator AT105 to input of attenuator AT106 (in 80 db X10,000 position of S107).
W112, RG-55/U Coaxial	P141 and P142	Applies rf signal from output of attenuator AT106 to rf switch S110 (in 80db X10,000 position of S107).
W113, RG-55/U Coaxial	P143 and P118	Applies rf signal from rf switch S110 to pre-selector mixer of rf tuning heads.
W114, RG-55/U Coaxial	P149 and P119	Applies 140 mc output signal from preamplifier to input of rf transfer switch S103.

TABLE XV. INTERCABLING CONNECTIONS, MONITOR UNIT (cont'd)

Cable Ref. Symbol and Type	Terminating Connectors	Cable Function
W115, RG-55/U Coaxial	P148 and P144	Applies attenuated 140 mc signal from terminal A of r-f transfer switch S103 to i-f attenuator AT107 (with S107 in any position except 0 db X 1).
W116, RG-55/U Coaxial	P145 and P146	Applies attenuated 140 mc signal from attenuator AT107 to terminal D of r-f transfer switch S103 (with S107 in any position except 0 db X 1).
W117, RG-55/U Coaxial	J153 and P135	Applies output of klystron signal calibrator to terminal 2 of r-f transfer switch S106 (with Monitor Unit " Function Selector Switch S105" in CALIBRATE POSITION).
W119, RG-55/U Coaxial	P147 and J104	Applies 140 mc output signal from terminal C of r-f transfer switch S103 to 140 mc output jack J104 (located on Monitor Unit front panel).
W120, RG-55/U Coaxial	P801 and P155	Applies 260 mc signal from the preselector-mixer (located in the r-f tuning head) to the i-f preamplifier.
W121, RG-55/U Coaxial	P153 and P156	Applies signal from signal generator output jack in tuning head to calibrate input jack on front panel of Monitor Unit.
W122, RG-55/U Coaxial	J104 and J16	Applies 140 mc signal from 140 mc Output Jack to 140 mc input jack (both jacks located on front panel).

TABLE XVI. INTERCABLING CONNECTIONS, TUNING UNIT

NOTE

Since the basic components in each of the Tuning Units are the same, Table XVI lists the intercabling connections for the Band 1 Tuning Unit, only. The information is applicable, however, to the other three tuning units, by changing the reference symbol series as follows:

500 Series - - - - - - - - - - - - - - - - Band 2 Tuning Unit

600 Series - - - - - - - - - - - - - - - - Band 3 Tuning Unit

700 Series - - - - - - - - - - - - - - - - Band 4 Tuning Unit

TABLE XVI. INTERCABLING CONNECTIONS, TUNING UNIT

Cable Ref. Symbol and Type	Terminating Connectors	Cable Function
W413, RG-9B/U Coaxial	P425 and Z402	Applies r-f signal from low-pass filter FL402 to preselector-mixer Z402
*W414, RG-71/U Coaxial	Z405 and P452	Applies 260 mc output signal from first crystal mixer CR401 to input of low-pass filter FL401.
W415, RG-71/U Coaxial	P454 and J455	Used in Band 1 only. Applies 260 mc output signal from output of low-pass filter FL401 to input of jack J801 of preamplifier chassis, via cable W120
W421, RG-55/U Coaxial	J409 and output probe of signal calibrator Z403	Applies output of klystron signal calibrator V401 to signal generator output jack J409 (with Monitor Unit "Function Selector" in CALIBRATE POSITION).

* Note: In Bands 2, 3, and 4, no low-pass filter is used. This cable leads directly to the input of the preamplifier chassis in these bands.

TABLE XVI. INTERCABLING CONNECTIONS, TUNING UNIT

Cable Ref. Symbol and Type	Terminating Connectors	Cable Function
W422, RG-55/U Coaxial	Z402 and Z404	Feeds the local oscillator signal to CR401
W423, RG-55/U Coaxial		Impedance matching cable
W424, RG-55/U Coaxial	Z405 and output probe of preselector Z402	Applies 260 mc output signal from first crystal mixer CR401 to tee connector Z405

50. TROUBLE SHOOTING.

Table XVII lists trouble symptoms and corrective measures as an aid in localizing a defect to a particular circuit. Reference should be made to the instrument block diagram, figure 36, and to the schematics located in section D of this instruction book. Use the meters mounted on the panel of the Power Unit to check all power supply voltages, as well as cathode current indications in both the local oscillator and signal calibrator klystron tubes.

TABLE XVII. TROUBLE SHOOTING CHART

Symptom	Probable Cause	Remedy
Low sensitivity.	1. Incorrect local oscillator cathode current indication, as shown on Power Unit KLYSTRON CATHODE CURRENT panel-mounted meter.	a. Check all voltages monitored by Power Unit VOLTMETER selector. Adjust screwdriver controls, accessible from front of Power Unit, as required. b. If malfunctioning is still present, readjust L.O. BIAS potentiometer, located at right-side of Tuning Unit chassis, per following chart: Band — Proper Indication 1 — *Approx 10-12 volts 2 — *Approx 10-12 volts 3 — **Approx 20-28 ma 4 — **Approx 20-28 ma *Measure with a 20,000 ohm-per-volt meter with positive prod at pin 5 and negative prod at pin 6. (TP405 for Band 1; TP505 for Band 2.) Set L.O. BIAS potentiometer for 10-12 volt indication, while observing KLYSTRON CATHODE CURRENT meter pointer deflection. Do not permit a meter pointer deflection greater than 28 milliamperes, to avoid shortening life of the klystron tube.

TABLE XVII. TROUBLE SHOOTING CHART (cont)

Symptom	Probable Cause	Remedy
Low sensitivity (cont).		**Observe KLYSTRON CATHODE CURRENT meter, with knob at LOCAL OSCILLATOR position, for pointer deflection between 20 and 22 ma. c. If malfunctioning is still present after performing step b above, refer to paragraph 62 for klystron tube replacement and realignment procedures.
	2. No pointer deflection on Monitor Unit power monitor meter, with METER SELECTOR switch in XTAL CUR position.	Any on-scale pointer deflection may show satisfactory operation. If meter pointer shows no deflection from zero position, proceed as follows: (1) Refer to figure 63, and observe that the output probe of the local oscillator is secured to the cavity by means of a hex nut. The probe has been carefully positioned and oriented at the production plant for proper operation. If hex nut has become loose, the trouble is due to a change in positioning of the probe within the cavity. CAUTION Do not change the probe position if the hex nut is tight, since further realignments and adjustments will then be necessary. (2) Check that the output connector of the first crystal mixer makes good electrical contact with the input to the preamplifier. NOTE On Band 1 Tuning Unit, the output of the first crystal mixer is applied to filter FL401 before being coupled to the preamplifier.

Symptom	Probable Cause	Remedy
Low sensitivity (cont) .		(3) Check that preamplifier output connector P102 makes secure electrical contact with its mating jack on the Tuning Unit. (4) The crystal detector within the first crystal mixer may be defective. Replace the crystal, if necessary.
	3. Incorrect sensitivity of the 260-mc signal which is applied to the input of the preamplifier. (Proper sensitivity is approximately four microvolts, at 3 db above noise level.) Proceed as outlined below: Use the internal signal calibrator to obtain a deflection on the OUTPUT METER. Peak up tuning slugs L801, T801, and T802 (in the preamplifier) to obtain the maximum pointer deflection on the OUTPUT METER.	a. First check that the 120-mc signal (from doubler V20 in the crystal-controlled oscillator chassis) is being applied to jack J803 on the preamplifier. Check as follows: (1) Unsolder the connection from feedthru capacitor C[illegible] to chassis ground. Insert a 1 ma. movement milliammeter in series with C8[illegible] to chassis ground. Proper indication is approximately 0.4 ma. (2) If 0.4 ma. indication cannot be obtained, refer to paragraph 53 for alignment of the crystal-controlled oscillator. b. Then check that the 180-mc signal (from tripler V19 in the crystal-controlled oscillator chassis) is being applied to jack J2 on the i-f amplifier chassis. Check as follows: (1) Disconnect coaxial plug P2 from its mating jack, J2. Connect an r-f detector from the center pin of P2 to chassis ground. Proper performance is indicated by a meter pointer deflection of at least 1.5 volts. (2) If the 1.5-volt indication cannot be obtained, refer to paragraph 53 for alignment of the crystal-controlled oscillator.

TABLE XVII TROUBLE SHOOTING CHART (cont)

Symptom	Probable Cause	Remedy
Low sensitivity (cont).		c. If trouble has not been localized as outlined in a and b above, use an fm sweeper, tuned to a center frequency of 140 mc, to check the bandwidth of the i-f amplifier. Proper bandwidth, as measured at the output of the i-f amplifier, is 4.8 mc at the six db-points on the response curve.
	4. Incorrect sensitivity of the 140-mc signal which is applied to the input of the i-f amplifier. (Proper sensitivity is approximately 5.5 microvolts.)	a. First check that output plug P147 is making good electrical contact with coaxial jack "C" on the r-f transfer switch S103. b. Then check that terminating connector P1, on cable W1 within the Monitor Unit, is making good electrical contact with jack J1 on the i-f amplifier. c. Repeat the trouble shooting procedure outlined in item 3, immediately above.
	5. Preselector is out of alignment.	a. Check to determine if the sensitivity is approximately constant over the range of the Tuning Unit, as follows: (1) Rotate the "function selector" to the CALIBRATE position. (2) Use the OUTPUT MET[illegible] indicating device. (3) Observe sensitivity on the SIGNAL CALIBRATOR OUTPUT ATTENUATOR dial. b. If the sensitivity is fairly constant, retune the preselector by repositioning

TABLE XVII TROUBLE SHOOTING CHART (cont)

Symptom	Probable Cause	Remedy
Low sensitivity (cont).		maximum sensitivity over the Tuning Unit frequency range. (See figure 62 for location of preselector tuning rods.) c. If the sensitivity varies considerably over the Tuning Unit frequency range, readjustment of each screw on the preselector cavity will be required. (Refer to paragraph 65.) Note that one procedure applies to the preselector of Bands 1 and 2; a second procedure applies to Bands 3 and 4.
Afc circuit is inoperative.	Defective afc circuit.	a. Refer to operating procedure. If afc cannot be balanced, trouble is localized to the Tuning Unit. b. Check the afc circuit alignment, as outlined in paragraph 59.
POWER ON lamp on Power Unit lights, [illegible] lamp on Monitor Unit does not light.	Wait for 60-second time delay for beam supply to be energized.	If KLYSTRON ON lamp DS3 does not light and VOLTMETER does not deflect with selector in BEAM position, check that the interconnecting cables (between the Monitor Unit and Power Unit and the Tuning Unit and Power Unit) are making good electrical contact.
Overheating of Power Unit.	Dirty filter, on Power Unit front panel.	Clean or replace the filter.
Weak audio output.	Defective audio amplifier and/or power amplifier.	a. Trouble shoot detector circuit in Monitor Unit. b. Replace tubes V25 and/or V26. c. Check that headset in use is a 600-ohm impedance type, and is in proper operating condition.

TABLE XVII TROUBLE SHOOTING CHART (cont)

Symptom	Probable Cause	Remedy
No video output.	1. Defective video amplifier V10, in i-f amplifier chassis.	a. Replace V10. b. Trouble shoot resistors and capacitors in V10 circuit for opens or shorts.
	2. Poor electrical contact between coaxial plug P5 and jack J5, on i-f amplifier chassis.	Check proper mating of plugs, and continuity of the RG-71/U cable W7 which terminates at VIDEO OUTPUT jack J13.
Front panel OUTPUT METER shows proper indications but external recording equipment is inoperative.	Defect in RECORDER OUTPUT jack circuit.	a. Check resistor R123 for open or short. b. Replace RECORDER OUTPUT jack J15. CAUTION The panel-mounted OUTPUT METER is connected in a high-voltage circuit. Always be sure to short-circuit the meter terminals, while trouble shooting the metering circuit. Failure to observe this precaution may result in damage to the meter.
OUTPUT METER shows proper indication when using external signal generator, but shows improper or zero indication when using internal signal calibrator.	1. Incorrect cathode current in signal calibrator klystron oscillator, as shown on KLYSTRON CATHODE CURRENT meter, with selector in SIGNAL CALIBRATOR position.	For Bands 1 and 2, check for indication of 10 to 12 volts dc across pins 4 and 6 of test points TP405 (Band 1 Tuning Unit) and TP505 (Band 2 Tuning Unit). Vary S.C. BIAS potentiometer, if required, to obtain proper indication. For Bands 3 and 4, check for indication of 20 to 22 milliamperes on KLYSTRON CATHODE CURRENT meter.

TABLE XVII TROUBLE SHOOTING CHART (cont)

Symptom	Probable Cause	
OUTPUT METER shows proper indication when using external signal generator, but shows improper or zero indication when using internal signal calibrator (cont).	2. If power-set indication is satisfactory throughout the band, but a true indication cannot be obtained on the OUTPUT METER, the trouble is localized to:	Disconnect P135 from terminal 2 of the r-f switch. Apply the output of the signal calibrator to a bolometer and power bridge (such as the Polytechnic Research type 650A or equivalent), as described in paragraph 67 of this section.
	a. R-f switch S106	With the SIGNAL CALIBRATOR POWER SET control adjusted to produce a pointer deflection to the CAL mark on the power monitor meter, the power bridge should indicate 1.0 milliwatt (0 db). Refer to paragraph 67 for the procedure to be used in resetting the attenuator.
	b. Attenuator probe in signal calibrator cavity is either improperly positioned or is defective.	
	3. Defective r-f coaxial switch S106 if power-set indication is satisfactory.	Check for continuity between terminal 2 and output terminal of r-f coaxial switch. CAUTION Operating power must be applied to the equipment, and the "function selector" must be in CALIBRATE position, to perform continuity check. If continuity cannot be established, replace r-f coaxial switch.
	4. If variation of SIGNAL CALIBRATOR POWER SET control does not produce CAL indication on the power monitor meter, alignment is required.	Refer to paragraph 56 for alignment procedure.

TABLE XVII TROUBLE SHOOTING CHART (cont)

Symptom	Probable Cause	Remedy
Power monitor meter pointer does not zero set.	Bridge circuit improperly set up.	a. Remove dust covers from the Monitor and Tuning Units. b. Orient the Tuning Unit so that the **left side is accessible. (See figure 63).** c. Rotate "function selector" to ZERO SET position. d. Rotate METER SELECTOR switch to POWER MON position. e. Rotate POWER MONITOR ZERO SET control completely clockwise. f. Rotate VOLTMETER selector on Power Unit to LOW VOLTAGE position. Check for pointer deflection to red line mark. Vary LOW VOLTAGE ADJ. control, if necessary, to obtain proper pointer deflection. g. Use a screwdriver to vary the BRIDGE COARSE ADJ. potentiometer, accessible at the **left side of each Tuning Unit, to obtain a full scale indication on the power monitor meter.** h. Readjust the POWER MONITOR ZERO SET front panel control, as necessary, to obtain a precise pointer deflection to the ZERO mark on the meter scale. i. If this indication cannot be obtained, trouble shoot the bridge circuit for the applicable circuit (R401 through R408 and RT401 through RT403 -- Band 1), (R501 through R508 and RT501 through RT503-- Band 2), (R601 through R608 and RT601 through RT603 -- Band 3), R701 through R708 and RT701 through RT703 -- Band 4), for defective components and/or connections.

TABLE XVII TROUBLE SHOOTING [illegible] (cont)

Symptom	Probable Cause	Remedy
Power monitor meter pointer does not zero set (cont).		Also check the Power Unit to determine that voltage regulator tube V224 is glowing. If this tube is not glowing, with power applied, trouble shoot the +120-volt power supply section, which includes tubes V217 through V224, with its associated resistors and capacitors.
Operator cannot hear a strong modulated tone, when a known cw signal is detected and the AURAL TUNING AID control is rotated clockwise, beyond its OFF position.	Defective audio oscillator, power amplifier, and/or audio amplifier-power amplifier.	Trouble shoot V21, V22, V25, and/or V26 on the Monitor Unit chassis. (See figure 56.
Quasi-peak or peak measurements cannot be made, while average measurements can be made.	Defective switching or meter weighting circuits.	Trouble shoot the [illegible] METER FUNCTION SELECTOR switch and the individual weighting circuits, as illustrated in figures 48 through 51.

51. GENERAL ALIGNMENT PROCEDURES

This portion of the Instruction Manual covers alignment procedures which may be required to restore the FIM to peak operating efficiency, following maintenance and repair. Unnecessary adjustments of the klystron local oscillator and signal calibrator circuits should not be made, since these changes may result in a loss of accuracy. The general procedure is outlined in the following paragraphs.

52. POWER SUPPLY, ALIGNMENT PROCEDURE (SEE FIGURES 54 and 55)

The procedure for checking and adjusting the power supply circuits for proper operation is as follows:

(1) Interconnect the Monitor Unit, the Tuning Unit, and the Power Supply

(2) Place the POWER ON-OFF switch in the ON position

(3) Using an accuracte AC voltmeter, check the 93VAC by connecting the voltmeter to the two test jacks just forward of the 93VAC ADJ R270

(4) If 93 volts ac is not indicated, adjust R270 until a 93 volt reading is obtained

(5) Check the power supply voltages in each position of the power supply multimeter switch. Correct voltages should be indicated within 20 seconds after power switch is turned on, when the multimeter is placed in the BIAS, LOW VOLTAGE, or REPELLER positions. In the BEAM position, allow approximately 1 minute for the beam supply voltage to come on.

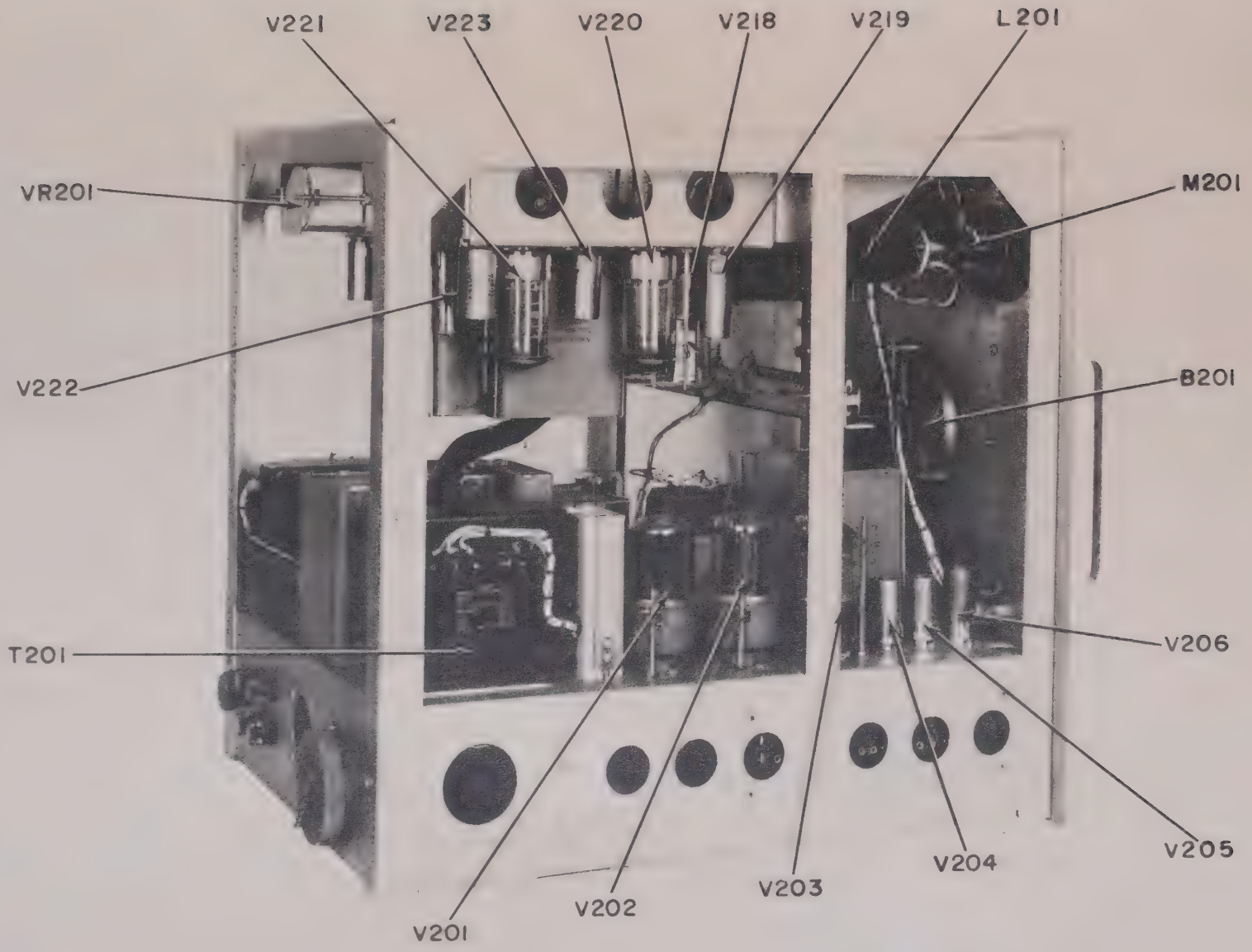


Figure 54. Power Unit, Right Side View, Parts Location Diagram

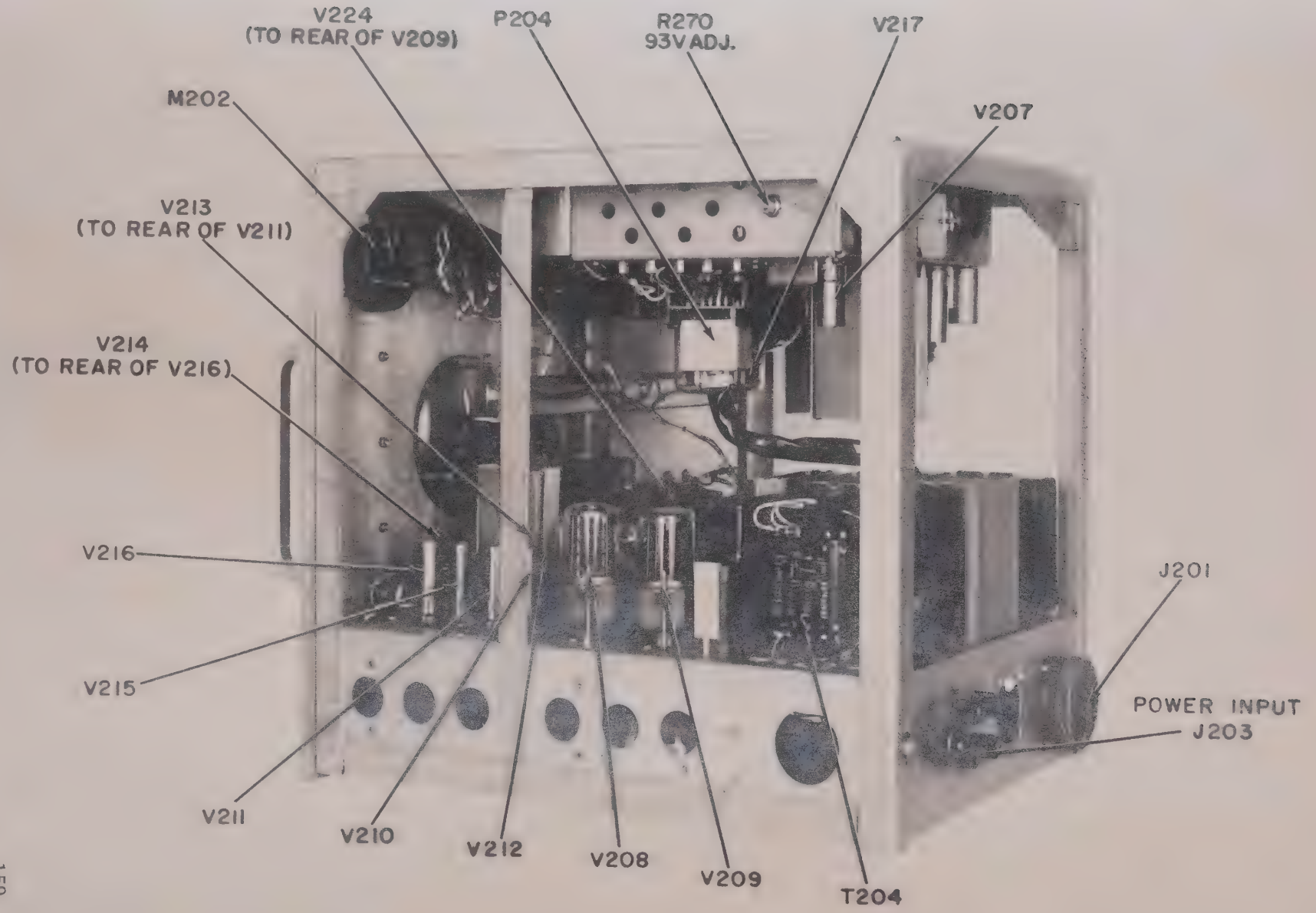


Figure 55. Power Unit, Left Side View, Parts Location Diagram

53. CRYSTAL-CONTROLLED LOCAL OSCILLATOR, ALIGNMENT PROCEDURE

a. INTRODUCTION. The Crystal-Controlled Local Oscillator chassis is mounted within the Monitor Unit. (See figure 56). Since the local oscillator circuits are crystal-controlled, field repair will require peaking adjustments and /or tube replacement.

b. PROCEDURE. To accurately align the circuit, proceed as directed in the following steps:

(1) Connect a d.c. vacuum tube voltmeter, through a 1 megohm resistor, between pin 2 and tube V17 and ground. Check the meter pointer deflects to an on-scale indication.

(2) If the meter pointer gives no deflection, vary the tuning slug of L86 to obtain a maximum pointer deflection on the VTVM.

NOTE: The tuning of variable coil L86 in the plate circuit of crystal oscillator V17 is critical.

(3) Reconnect the VTVM between pin 1 of tube V18 and ground.

(4) Adjust L87 for a maximum indication on the VTVM.

(5) Reconnect the VTVM between pin 1 of tube V19 and ground.

(6) Adjust L89 for a maximum indication on the VTVM.

(7) Connect a 50 ohm detector from the 180 mc output connector J9 to ground.

(8) Connect the VTVM to the output of the detector and adjust T4 for a maximum indication on the VTVM.

(9) Reconnect the 50 ohm detector from the 120 mc output J10 to ground.

(10) Connect the VTVM to the output of the detector and

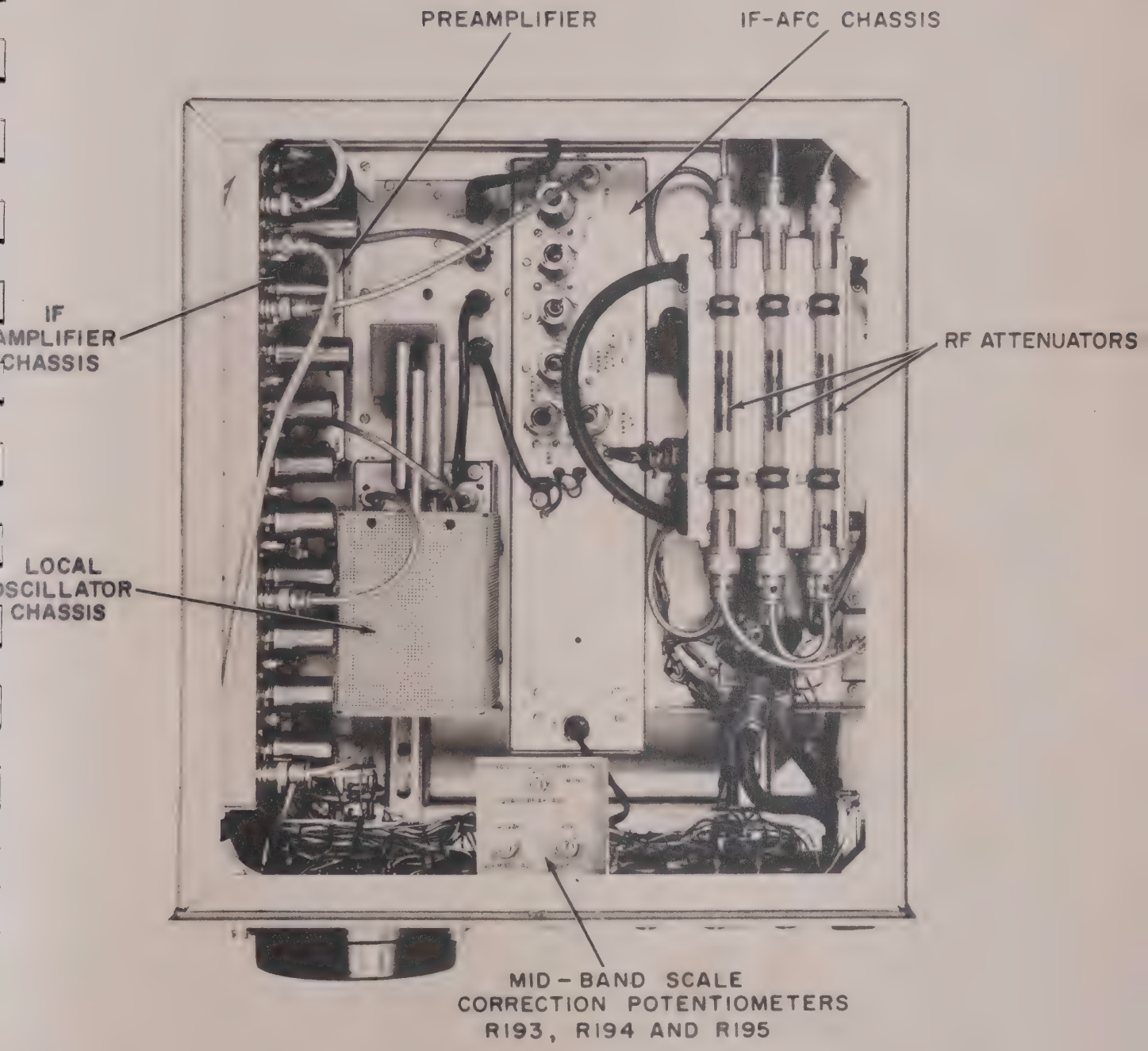


Figure 56. Monitor Unit, Top View Showing Location of Subchassis

adjust T5 for a maximum indication. The voltage reading at these points should be approximately 1 to 1.5 volts.

(11) If the outputs specified above are not obtained, check the grid voltages of the tubes in the local oscillator chassis. Use a low capacity probe with a high series resistor, such as a 1-megohm, 1/2 watt resistor, for these measurements. The following voltage measurements indicate satisfactory performance:

(a) V17, pin 2 . . . . . -1.5 v dc

(b) V18 . . . . . -3 v dc

(c) V19 . . . . . -15 v dc

(d) V20 . . . . . -15 v dc

54. 140-40-MC I-F AMPLIFIER, ALIGNMENT PROCEDURE.

a. INTRODUCTION. The 140-40 -mc i-f amplifier is mounted within the Monitor Unit as shown in figure 56. A signal generator, with a calibrated output, covering the frequency from approximately 37 mc to 145 mc, is required as the signal source for the alignment procedure.

b. 40-MC STAGES. To align the 40-mc stages, proceed as follows:

(1) Rotate I.F. GAIN control fully COUNTERCLOCKWISE.

(2) Short out the AGC by connecting a ground lead to the center conductor of test point TP2 on the i-f amplifier chassis.

(3) Short out the scale tracking circuit by connecting a clip lead from TP3 to ground.

(4) Set OUTPUT METER FUNCTION SELECTOR switch to AVERAGE position.

(5) Disconnect coaxial plug P5 from its mating receptacle J5. Connect a 10,000-ohm resistive load from J5 to chassis ground.

(6) Remove coaxial plug P2 from jack J2.

(7) Feed a 40-mc signal from the signal generator into J2.

(8) Connect the VTVM from test point TP1 to chassis ground.

(9) Then peak the following tuning coils in the sequence indicated below:

Sequence	Signal Generator Setting	Tuned Circuit to be Adjusted
1st	40.0 mc	T2
2nd	37.5 mc	L33
3rd	42.6 mc	L27
4th	37.7 mc	L23
5th	42.3 mc	L18

(10) After satisfactory peaking indications have been obtained, re-apply the 180-mc signal by reconnecting coaxial plug P2 to J2.

c. 140-MC STAGES. To align the 140-mc stages, proceed as follows:

(1) Disconnect coaxial plug P1 from jack J1.

(2) Connect signal generator through a pad to jack J1.

(3) Feed in a 140-mc signal and adjust T1 and L13 for a maximum indication in the VTVM.

(4) Detune L4 and L8 by retracting the slug of L4 as far as possible, and inserting the slug of L8 as far as possible into the coil form.

(5) Locate the center frequency response, at the 6 db points. For explanation purposes, assume the center frequency to be 139.8 mc.

(6) Retune L13 for a maximum output indication.

(7) Adjust L8 for the center frequency response, minus 3 mc (136.8 mc in our example).

(8) Adjust L4 for the center frequency response plus 3 mc (142.8 mc in our example).

d. CHECK OF BANDWIDTH. To check the i-f amplifier bandwidth, proceed as follows:

(1) At the 3 db points, a bandwidth indication of 4.5 mc shows satisfactory equipment performance.

(2) At the 6 db points, a bandwidth of 5.4 mc shows satisfactory performance.

(3) The overall sensitivity for a signal = twice noise, is 4 microvolts, where the noise level is 1.5 volts (at maximum gain).

e. IMPROVING BANDWIDTH CHARACTERISTICS OF THE I-F AMPLIFIER.

(1) EQUIPMENT REQUIRED. A sweep generator producing an output at 140 mc with a ± 5 mc deviation, is required for the following procedure. In addition, an oscilloscope, having facilities for accepting an external sweep signal, is required.

(2) PROCEDURE.

(a) Apply the r-f output of the sweep generator, operating at a frequency of 140 mc with a sweep deviation of ± 5 mc, to the 140 MC IN jack J16.

(b) Connect the vertical input of the oscilloscope to coaxial jack J5 on the i-f amplifier.

(c) Connect the generator sweep output signal to the horizontal input of the scope.

(d) Observe the response curve of the i-f amplifier strip on the oscilloscope screen.

(e) For improved accuracy in the adjustment procedure, remove the short circuiting lead which was connected from TP3 to chassis ground at the start of the alignment procedure.

NOTE

Do not returne the setting of transformer T1 in the following procedure.

(f) Trim tuning adjustments T2, L33, L27, L23, L18, L13, L8, and L4, in sequence, to improve the shape of the response curve.

55. PREAMPLIFIER, ALIGNMENT PROCEDURE. (See figures 56, 57, and 58)

a. INTRODUCTION. The preamplifier is mounted at the top of the monitor unit chassis. (See figure 56.) If alignment of this circuit is required, use a signal generator (such as Measurement Corp. Model 80 Standard Signal Generator, or equivalent). The Signal generator must cover the frequency range from approximately 250 to 270 mc, at an amplitude level up to 0.1 volt output.

b. TEST SETUP.

(1) Connect a VTVM at test point TP1, on the i-f amplifier chassis, to observe the output voltage during the alignment procedure.

(2) Set up the Monitor Unit front panel controls for normal operation.

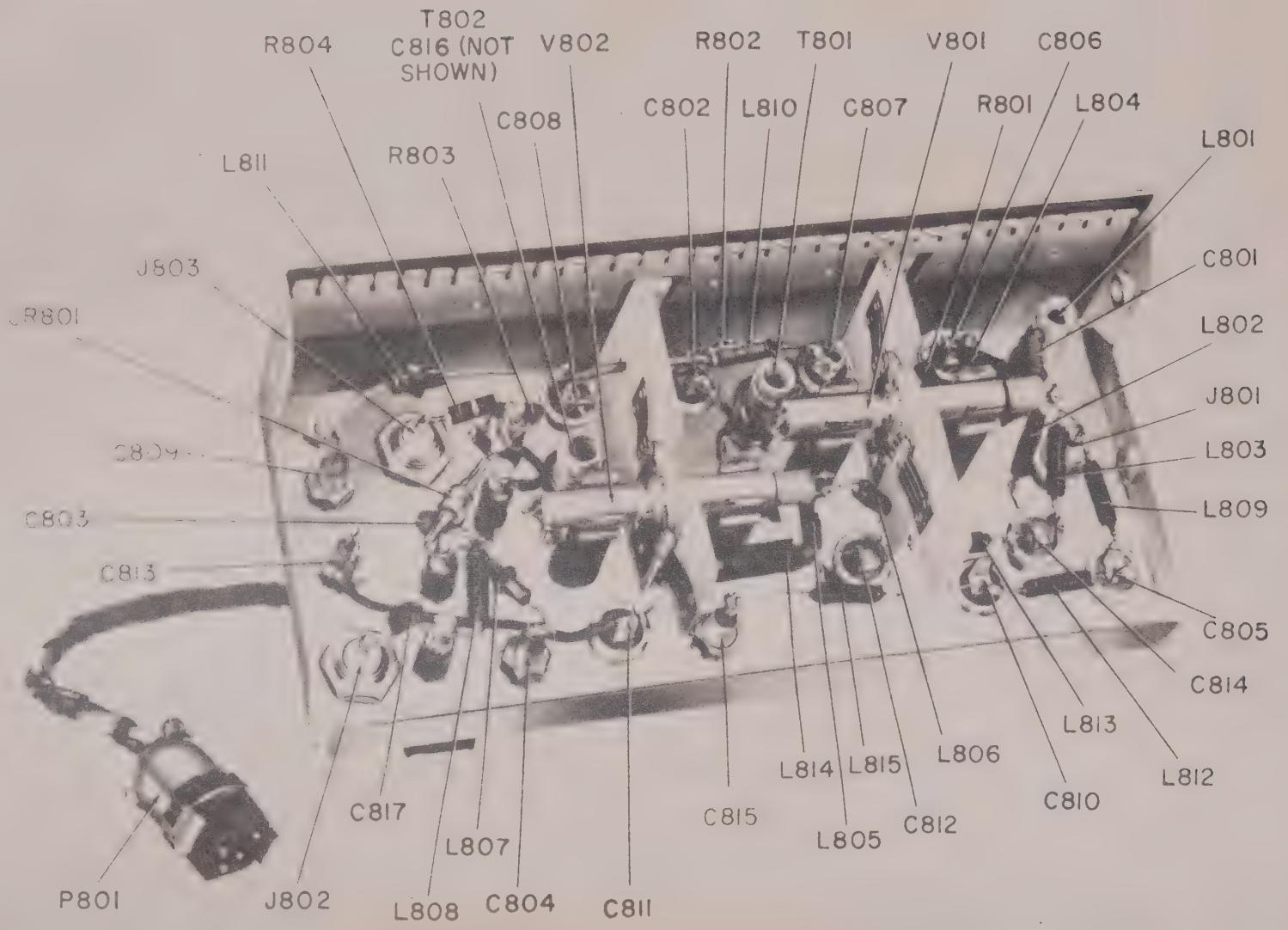


Figure 57. Preamplifier, Component Location Diagram

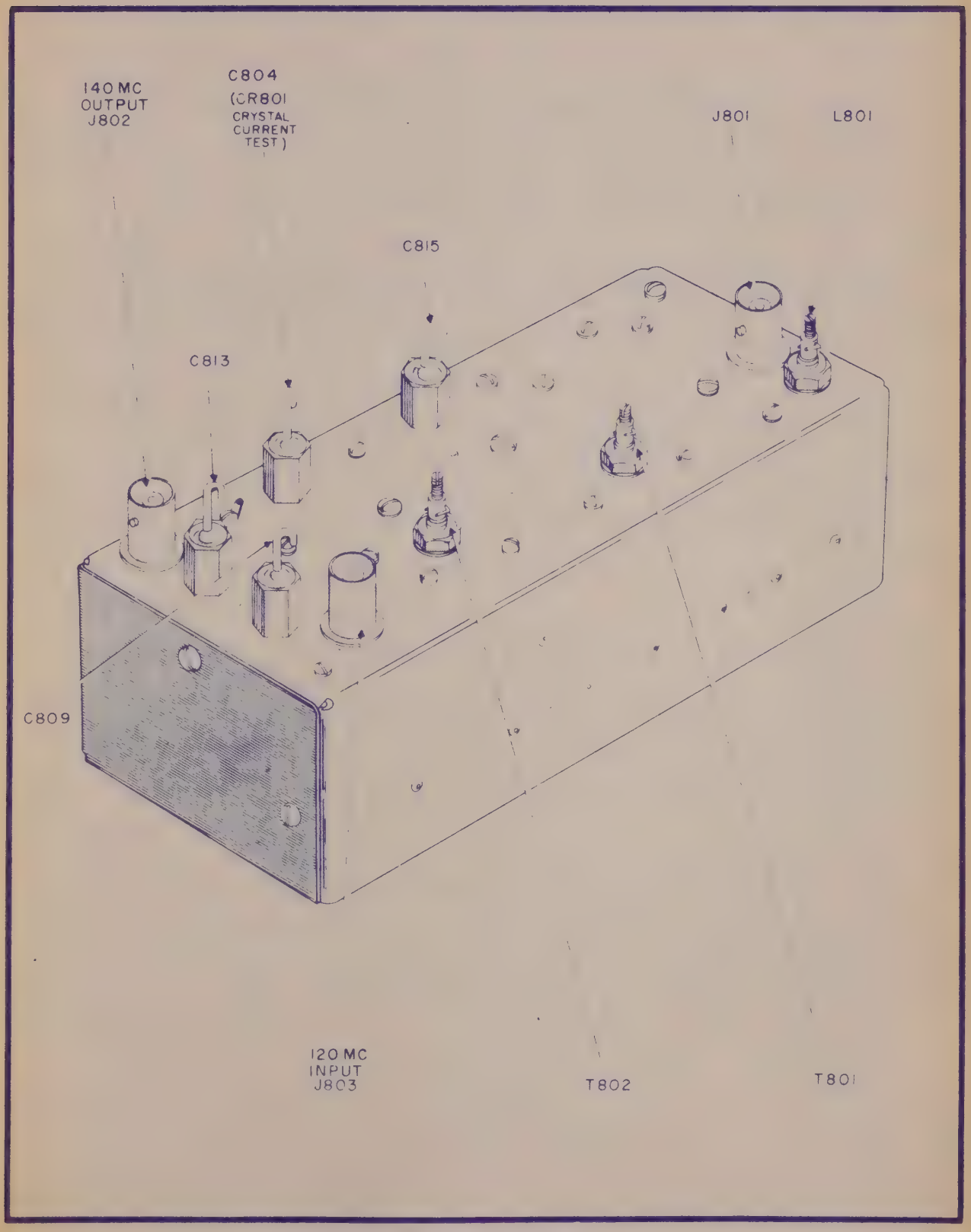


FIGURE 58. PREAMPLIFIER,
TOP VIEW OF CHASSIS.

(3) Short out TP 2 and TP3 by connecting a jumper between the test point and ground. (TP2 is located on the IF amplifier chassis).

(4) Connect the output of the signal generator to the preamplifier input jack J801.

(5) Tune the signal generator to produce an output signal of 260 mc.

(6) Adjust the IF GAIN control, on the monitor unit front panel, to mid-position. This control setting determines the noise level of the IF amplifier.

(7) Adjust T802, T801, and L801, on the preamplifier chassis, to obtain a maximum indication on the VTVM. Reduce the output level of the signal generator, if necessary, to keep the meter pointer on scale.

(8) Remove ground on TP2.

(9) Measure the bandwidth of the preamplifier by tuning the signal generator to approximately 260 mc. A bandwidth measurement of 4.5mc to 5mc, at the 6db points, and a sensitivity of 3 microvolts or better at the signal equal to 1.4 times noise, indicates satisfactory equipment performance.

(10) Measure the noise level by rotating the IF GAIN control, on the monitor unit front panel, to its full clockwise position. An indication that is equal to or greater than 1.0 volt is satisfactory.

(3) Turn the OUTPUT METER FUNCTION SELECTOR switch to ZERO SET position.

(4) Disconnect cables from jacks J1 and J2, on the i-f amplifier chassis.

(5) Connect a VTVM between the center tap of R194 and ground, and adjust R194 for maximum negative voltage (approx. -7 volts dc.)

(6) Connect a 20,000 ohm-per-volt dc voltmeter to test point TP4, and vary the setting of F.I. LOW SET potentiometer R135 to obtain an indication of 0.75 volts on the meter. Lock the shaft of R135 to secure this setting.

(7) Connect the output of a signal generator, producing a signal of 140 mc at 4 microvolts, at the input to the i-f amplifier, J1.

(8) Remove the dc voltmeter from TP4, and connect the voltmeter to test point TP3 on the audio, video, and metering circuits chassis. Adjust the setting of the SCALE TRACKING potentiometer R144 to obtain a 1 volt reading on the meter.

(9) Adjust the I.F. GAIN control for a 10 microvolt reading on the OUTPUT METER.

(10) Increase the output of the signal generator to 400 microvolts.

(11) Rotate the METER GAIN SET potentiometer R117 until the OUTPUT METER pointer deflects full scale.

NOTE: Repeat steps 7 through 11 as many times as necessary in order to eliminate interaction.

(12) Disconnect the signal generator.

(13) Connect the preamplifier output to the i-f amplifier.

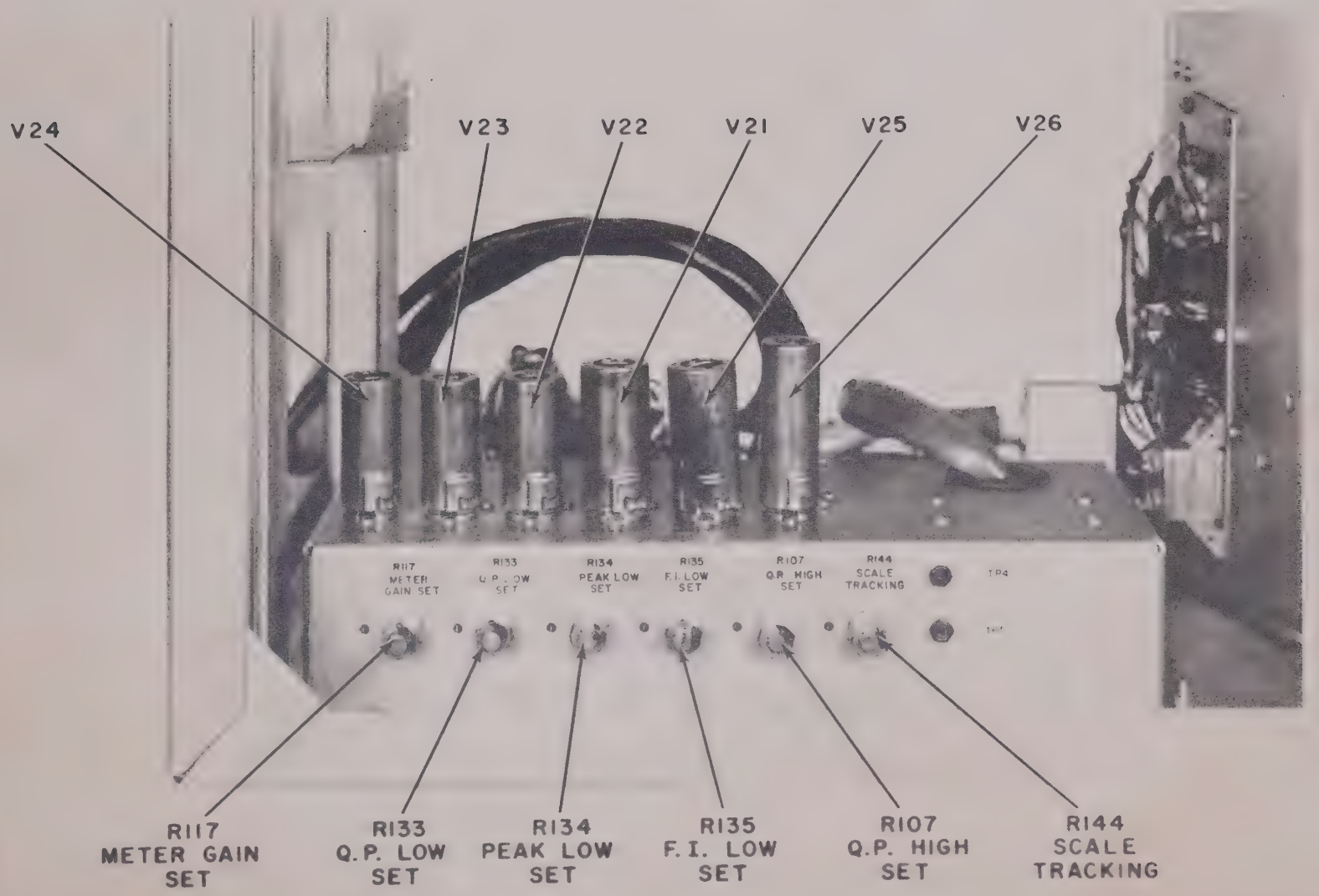


Figure 59. Audio, Video, and Metering Circuits Chassis, Top View

(14) Rotate the I.F. GAIN control to the maximum position.

(15) Adjust the SCALE TRACKING potentiometer R144 until the pointer on the OUTPUT METER is deflected at least to 35 microvolts.

(16) Disconnect the preamplifier, and connect the signal generator to the 140 mc i-f input.

(17) Repeat steps 7 through 11, except DO NOT ADJUST R144 (step 8.)

(18) Plot a curve of Meter Error vs. Signal Level at 5 db increments. A typical curve is shown in figure 60.

NOTE: IF THERE ISN'T AN ERROR OF MORE THAN 1/2 DB ALONG THE SCALE, THE MID-SCALE POTENTIOMETER R194 NEED NOT BE ADJUSTED.

IT IS RECOMMENDED THAT ALIGNMENT ACCURACY BE RE-CHECKED SEVERAL TIMES BEFORE ADJUSTMENT OF R194.

(19) If there is an error of more than 1/2 db along the scale, proceed in the following manner:

a. Adjust R194 until the VTVM reads -4 volts dc.

b. Repeat previous tracking alignment (step 18.)

c. If the error is still greater than 1/2 db, adjust R194 for a reading of -3.5 volts.

d. Repeat tracking alignment.

e. Continue to decrease the voltage of R194 by 0.5 volts increments, until the error is less than 1/2 db.

NOTE For the average i-f strip, R194 need not be adjusted for less than -2.5 volts.

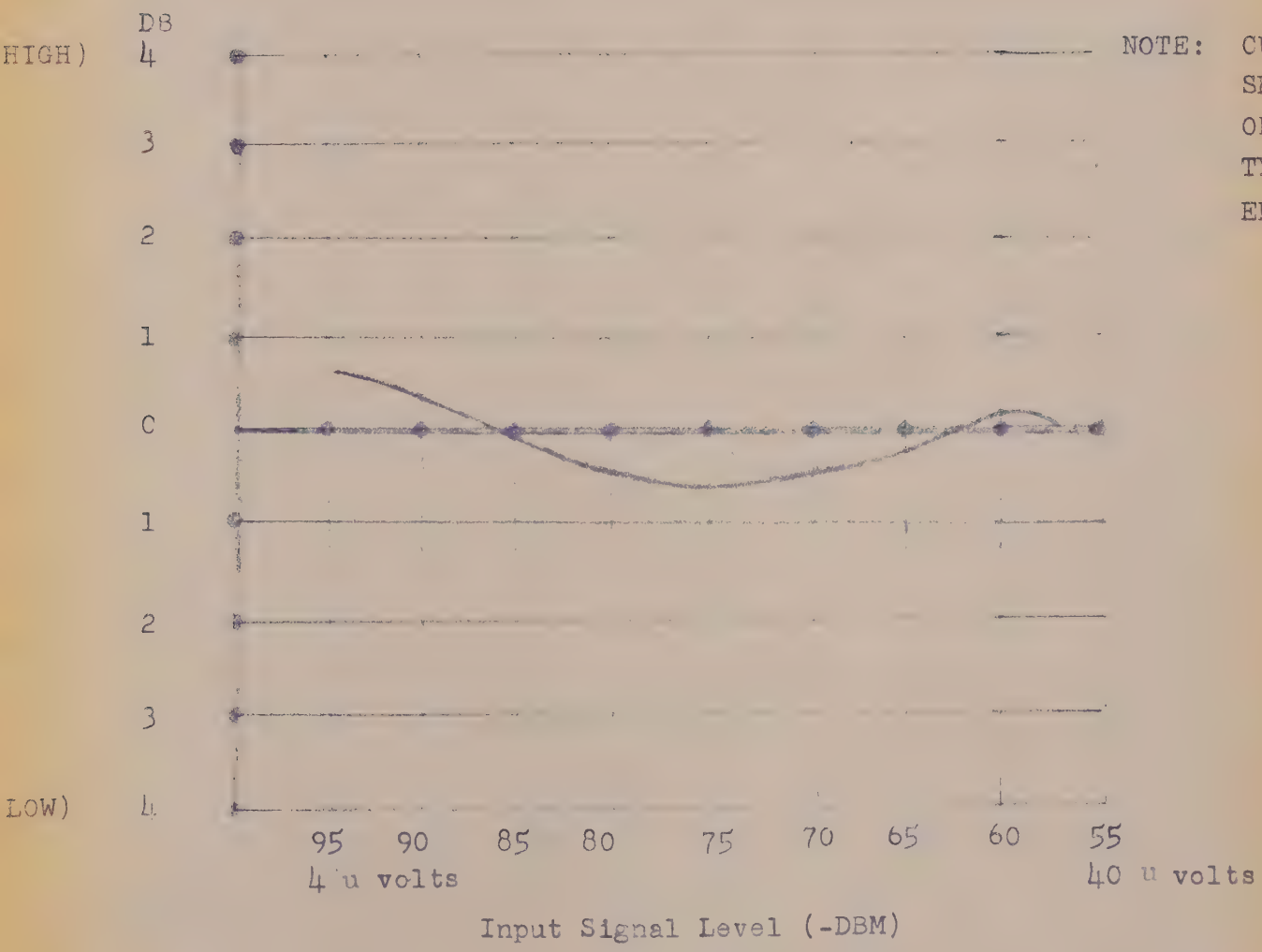


Figure 60. Meter Tracking Curve

57. ADJUSTMENT PROCEDURE FOR QUASI-PEAK POSITION OF OUTPUT METER FUNCTION SELECTOR. (See figure 59.)

a. INTRODUCTION. Before proceeding with the following adjustments, the output meter tracking circuit must have been correctly tracked for the AVERAGE position of the OUTPUT METER FUNCTION SELECTOR switch, as outlined in paragraph 56. In addition, the I.F. GAIN control on the Monitor Unit front panel must be set as finally determined for the acceptable meter tracking curve error, as shown in figure 60. After these two sets of conditions have been satisfied, proceed with the adjustment of the QUASI-PEAK circuit as directed in the following procedure.

b. PROCEDURE.

(1) PLACE THE OUTPUT METER FUNCTION SELECTOR switch in the ZERO SET position.

(2) Connect a VTVM between the center tap of R193 and ground, and adjust R193 for the same voltage as obtained in step 19 of paragraph 56.

(3) Adjust the OUTPUT METER ZERO SET control to obtain a pointer deflection on the OUTPUT METER to the extreme left-hand scale mark.

(4) Connect the output of a signal generator, producing a signal of 140 mc at 4 microvolts, at the input to the i-f amplifier, J1.

(5) Place the OUTPUT METER FUNCTION SELECTOR switch in the QUASI-PEAK position.

(6) Adjust the Q.P. LOW SET potentiometer R133 on the audio, video, and metering circuits chassis (figure 59) to obtain a 10 microvolt reading on the OUTPUT METER.

(7) Increase the output of the signal generator to 400 microvolts.

(8) Adjust the Q.P. HIGH SET potentiometer R107 (figure 59) to obtain a 1,000 microvolt reading (full scale) on the OUTPUT METER.

NOTE: Steps 4 through 8 should be repeated several times to eliminate interaction between the two control settings.

(9) Plot a curve of Meter Error vs. Signal Level at 5 db increments. A typical curve is shown in figure 60.

(10) If there is an error of more than 1/2 db along the scale, decrease the voltage of R193 by 0.5 volt increments, until the error is less than 1/2 db.

58. ADJUSTMENT PROCEDURE FOR PEAK POSITION OF OUTPUT METER FUNCTION SELECTOR.

a. INTRODUCTION. Before proceeding with the following adjustments, the OUTPUT METER must have been correctly tracked for the AVERAGE and the QUASI-PEAK positions of the FUNCTION SELECTOR switch, as outlined in paragraphs 56 and 57.

b. PROCEDURE.

(1) Reconnect the preamplifier output cable (140 mc) to J1, at the input to the 140/40-mc i-f amplifier.

(2) Connect a VTVM between the center tap of R195 and ground, and adjust R195 for the same voltage as obtained in step 10 of paragraph 57.

(3) Select any Tuning Unit and use a microwave signal generator of the appropriate frequency range. The signal generator should have provision for pulse modulation.

(4) Zero-set the OUTPUT METER.

(5) Switch the Tuning Unit FUNCTION SELECTOR to the FIM position and set the output control of the signal generator to a cw level of 1,000 microvolts.

(6) Place the OUTPUT METER FUNCTION SELECTOR switch in the AVERAGE position. With the receiver tuned to the incoming signal, adjust the I.F. GAIN control for a deflection on the OUTPUT METER of 1,000 microvolts (or 60db on the red db scale).

(7) Switch the signal generator to produce square wave modulation, at some audio rate. If square wave modulation is unobtainable on the signal generator, a duty cycle of one percent or greater can be used. Make sure that peak pulse level is equal to the cw level.

(8) Slight retuning of the FIM may be necessary. This can be done with the OUTPUT METER FUNCTION SELECTOR switch in the QUASI-PEAK position.

(9) Plug a 600-ohm headset into the AUDIO OUTPUT jack, on the Monitor Unit front panel.

(10) Place the OUTPUT METER FUNCTION SELECTOR switch to its PEAK postion.

(11) Rotate the SLIDEBACK control fully counterclockwise.

(12) Adjust the AUDIO GAIN control for a comfortable listing level.

(13) Rotate the SLIDEBACK control clockwise to full scale pointer deflection on the OUTPUT METER.

(14) Adjust the PEAK LOW SET potentiometer R134 (figure 59) until the sound intensity in the headset sharply diminishes meanwhile, maintain a full-scale pointer deflection on the OUTPUT METER by simultaneously readjusting the SLIDEBACK control.

b. PROCEDURE. To align the AFC circuit, proceed as follows:

(1) Connect a signal generator, set for 40 mc and an output of 50,000 microvolts, to J6.

(2) Connect a VTVM, set for negative dc, through a 1 megohm resistor, between pin 1 of V12 and ground.

(3) Tune L67 for a maximum indication on the VTVM.

(4) Reconnect the VTVM to pin 1 of V13 and adjust L59 for a maximum reading on the voltmeter.

(5) Reconnect the VTVM to pin 1 of V14 and adjust L62 for a maximum reading on the VTVM.

(6) Reconnect the VTVM to the junction of C112 and R67, reducing the signal generator output to produce a .5 volt indication on the VTVM.

(7) Adjust L64 for a maximum indication on the VTVM.

(8) Increase the signal generator output to 50,000 microvolts.

(9) Rotate the NOISE BALANCE control to its mid range.

(10) Set the VTVM to the 15v scale and zero adjust the meter to that "0" volts is center scale.

(11) Connect the VTVM across C129.

(12) Feed in a 38.25 mc signal from the signal generator into J6, and adjust L67 for a maximum indication on the VTVM.

(13) Reset the signal generator to 41.75 mc and adjust L69 for a maximum reading on the VTVM.

(14) Reset the signal generator to 40mc and adjust the NOISE BALANCE potentiometer so that at 40mc the VTVM pointer indicates "0" at center scale.

(15) Vary the signal generator frequency from 38.25 to 41.75mc and the range of indicated values should correspond to the graph as shown in figure 61.

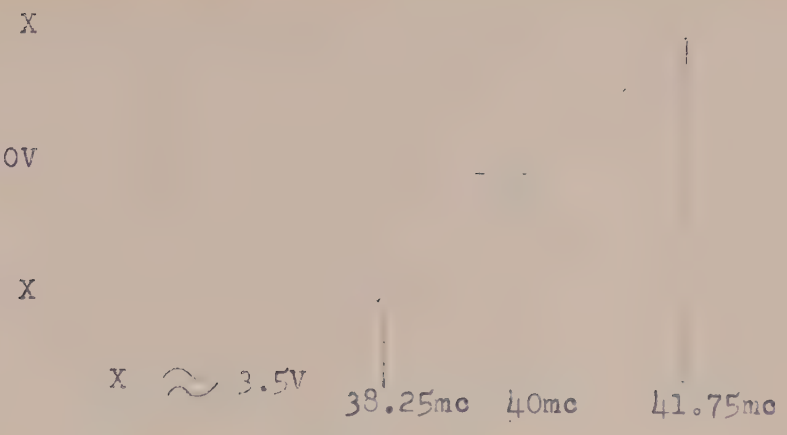


FIGURE 61. Frequency vs. D.C. Output

NOTE: 0 volts should fall at the 40mc mark and the "X" values should be approximately equal at 38.25mc and 41.75mc. If the above results cannot be obtained, V15, V16, or CR1 and CR2 should be replaced and the complete discriminator alignment procedure should be repeated.

60. COMPLETING CHASSIS ALIGNMENT

After the alignment of the individual chassis has been completed, it will be necessary to touch up certain adjustment, to account for impedance of interconnecting cables. To accomplish this, proceed as follows:

(1) Connect all interconnecting cables.

(2) Connect a signal generator, set to 260mc, to the preamplifier input jack J801.

(3) Short out TP2 and connect a VTVM to TP1.

(4) Adjust T802, on the preamplifier chassis, for a maximum indication on the VTVM.

(5) Adjust T5; on the localoscillator chassis, for a maximum indication.

(6) Repeat steps 4 and 5, as necessary, until a peak indication is noted on the VTVM.

(7) Reconnect the signal generator, set for 140mc, to the 140mc input jack on the equipment front panel.

(8) Adjust T1 on the IF Amplifier chassis and T4 on the local oscillator chassis for maximum indications.

(9) Repeat step 8, as necessary, until a peak reading is indicated on the VTVM.

(10) Reconnect the VTVM to TP6, on the AFC chassis.

(11) Adjust T3, on the AFC chassis, for a maximum reading on the VTVM.

(12) Adjust T2, on the IF chassis, for a maximum indication on the VTVM.

61. TROUBLE SHOOTING THE TUNING UNITS (See figures 62, 63, and 64)

a. MECHANICAL

(1) The mechanical drive system employed in the Tuning Units of the equipment should not be tampered with unless a mechanical breakdown occurs. MECHANICAL READJUSTMENT SHOULD BE MADE ONLY AS A LAST RESORT AND ONLY BY THOROUGHLY COMPETENT PERSONNEL.

b. ELECTRICAL

(1) If the FIM shows improper functioning or reduced sensitivity, localize the trouble to the Monitor Unit, the Power Unit, or to one of the four Tuning Units supplied with the equipment. Refer to Table XVII for a detailed trouble shooting procedure.

(2) Another method by which trouble can be localized, is to replace the Tuning Unit showing unsatisfactory performance

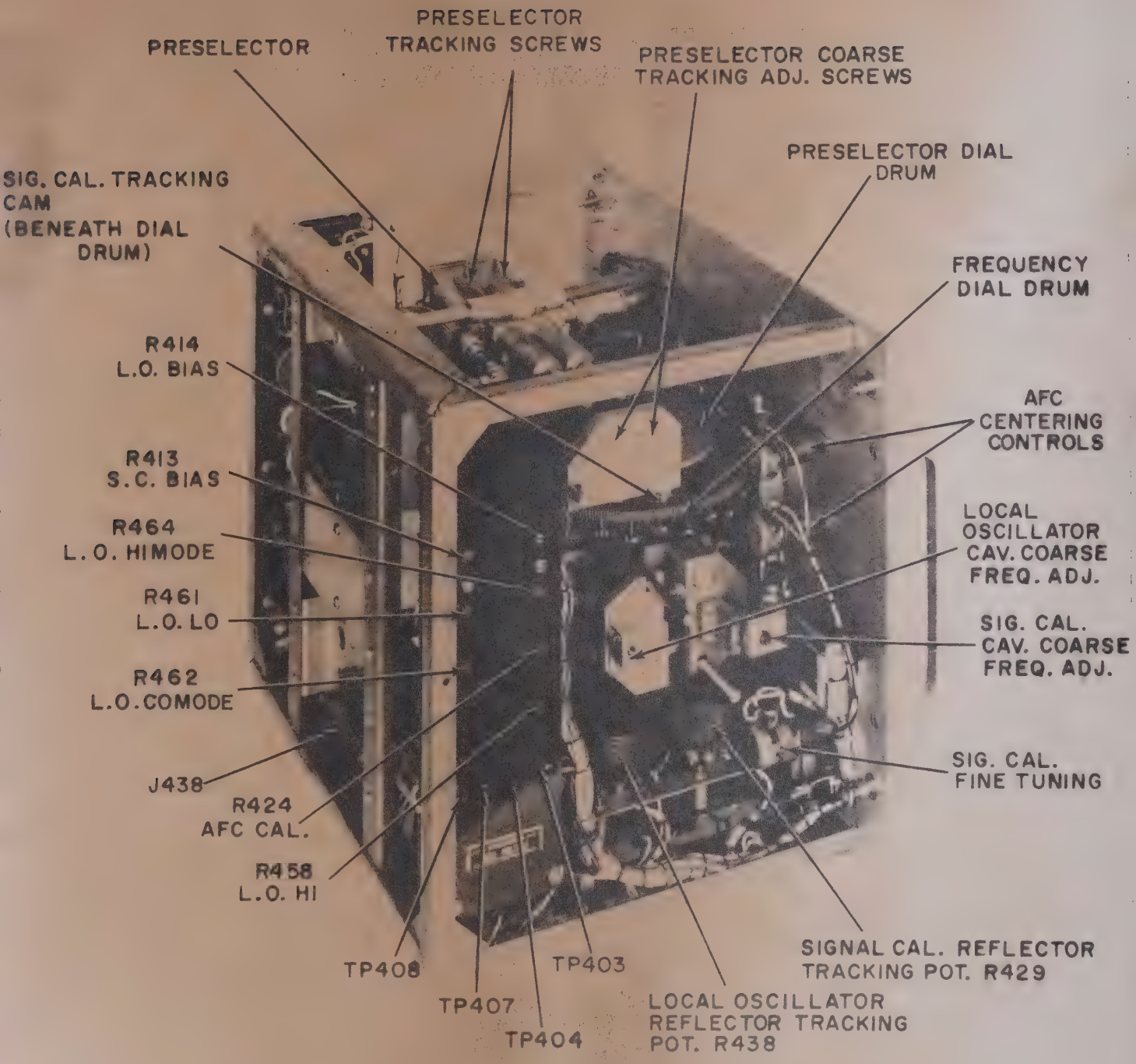


Figure 62. Typical Tuning Unit, Right Side View of Chassis

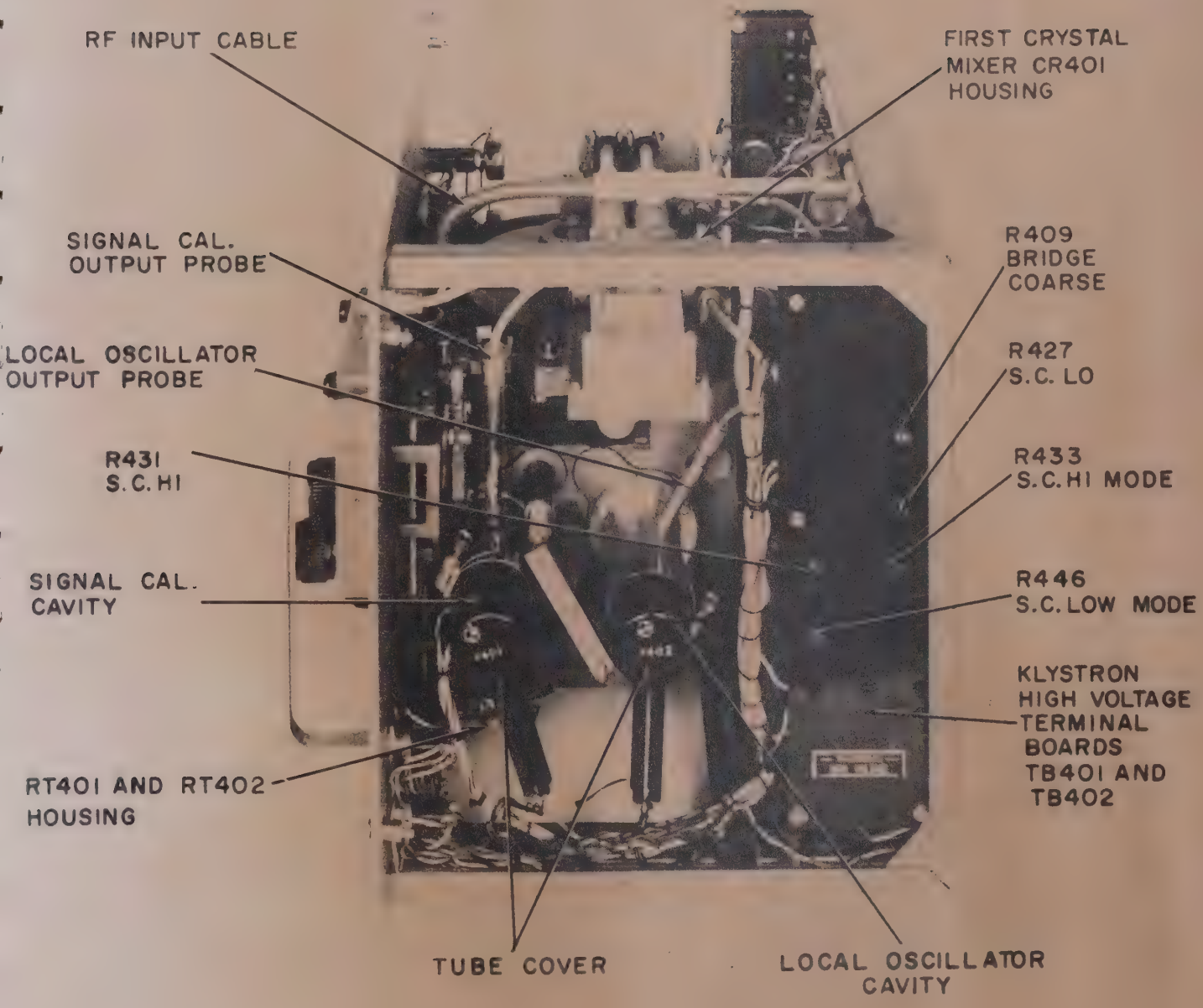


Figure 63. Typical Tuning Unit, Left Side View of Chassis

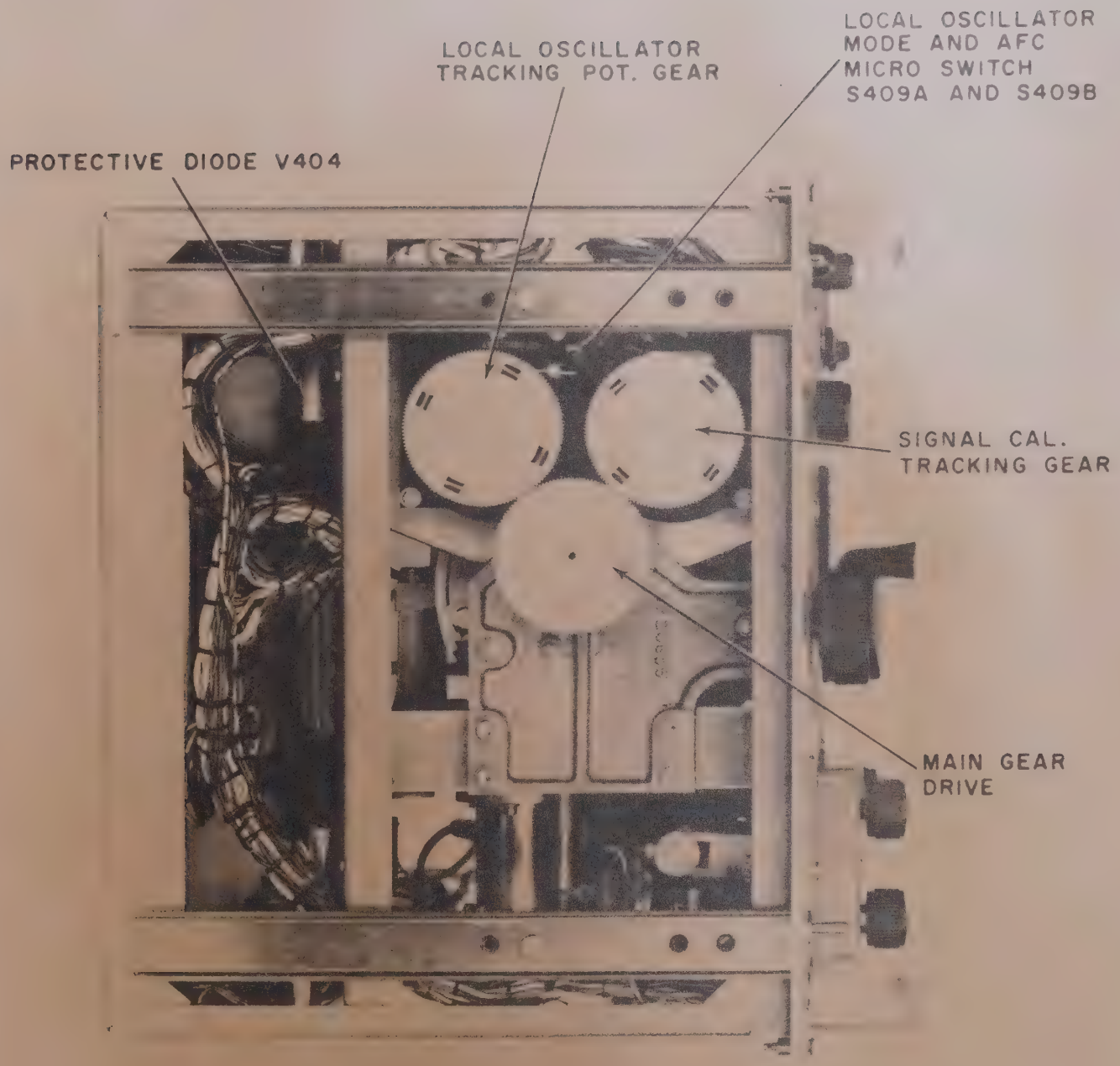


Figure 64. Typical Tuning Unit, Bottom View of Chassis

with one of the other Tuning Units (known to be functioning properly) that covers a different frequency range. If the equipment now performs satisfactorily, the trouble has been localized to a particular Tuning Unit. On the other hand, should the equipment still show malfunctioning, the trouble most likely will be found in either the Monitor Unit or the Power Unit.

(3) Once the trouble has been localized to a particular Tuning Unit, perform a check of the sensitivity, through the pre-amplifier and i-f amplifier, as described in paragraph 54.

(4) Check for proper voltage and current readings on the panel-mounted meters of the instrument. Insufficient crystal current, as indicated on the power monitor meter, may require replacement of the first crystal mixer within the Tuning Unit showing malfunctioning.

b. PRELIMINARY CHECK OF TUNING HEADS

Before installation of a klystron tube, the voltage present at the klystron tube socket must be measured. The following voltages should be available at the pins of the klystron tube socket:

(1) Pin 2 and 4: 6.3 volts ac, klystron filament voltage.

(2) Pin 3: anode voltage

(3) Pin 1: grid voltage

(4) Table XVIII lists the anode voltages for the Band 1 through 4 RF Tuning Units.

TABLE XVIII-ANODE VOLTAGES

BAND	ANODE VOLTAGE
1	-325vdc
2	-325vdc
3	-1000vdc
4	-1250vdc

(5) Varying the klystron bias potentiometers should vary the voltage between pins 3 and 1 of the klystrons. The voltage should vary smoothly from 0 to 50 volts.

(6) Vary the frequency tuning control from the low end to the high end while monitoring the repeller voltage with respect to the anode. As the frequency is increased, the repeller voltage should rise smoothly. The Bands 1 and 4 contain microswitches to switch modes.

(7) Reflector voltage variation for Bands 1 and 4 is illustrated in figure 65 shown below.

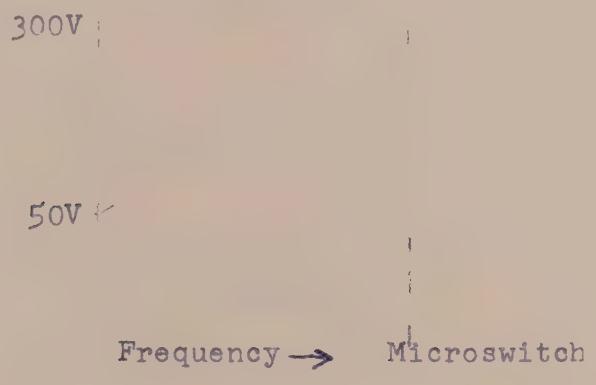


Figure 65. Bands 1 and 4 Reflector Voltage Variations

(8) At various setting of the frequency dial, for example, the low, middle, or high ends, vary the appropriate adjustment (low potentiometer, low mode potentiometer, high mode potentiometer, etc) and observe whether the reflector voltage varies smoothly. This is illustrated in figure 66 below.

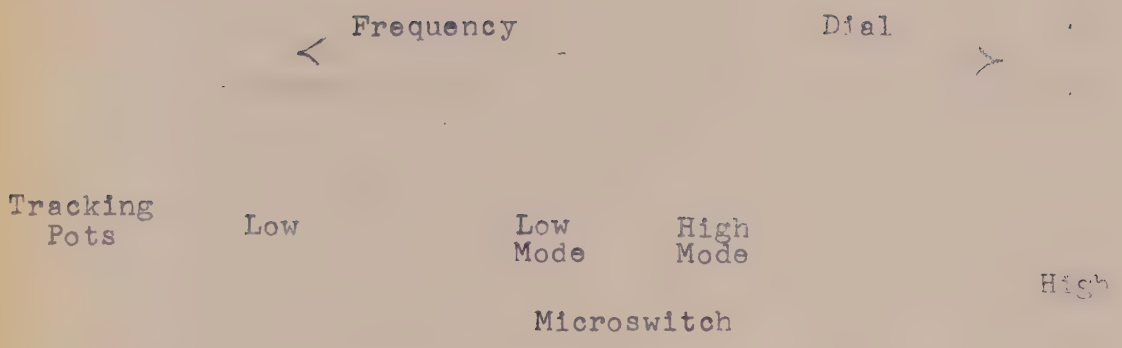


Figure 65. Frequency Anode Switching

(9) Table XIX lists the bias and beam current which is available in each of the tuning units.

TABLE XIX BIAS & BEAM CURRENT, TUNING UNITS

BAND	SIGNAL GENERATOR			LOCAL OSCILLATOR		
	TUBE TYPE	BIAS	BEAM CURR.	TUBE TYPE	BIAS	BEAM CURR.
1	5837	+10V	28ma	6BM6 or 5837	0V +10V	28ma
2	5836	+10V	28ma	6BL6 or 5836	0V +10V	28ma
3	5721 or 6390	+10V	20ma	5721 or 6390	+10V	20ma
4	5721 or 6390	+10V	20ma	5721 or 6390	+10V	20ma

62. FIRST LOCAL OSCILLATOR, TUBE REPLACEMENT PROCEDURE. (See Figures 62 and 63).

a. INTRODUCTION. The Tuning Units covering each frequency range employ various types of klystron oscillator tubes, as indicated in table XIX.

b. DISASSEMBLY PROCEDURE. Each klystron tube is partially seated within the right end of the oscillator cavity, as viewed from the equipment front panel. The tube base is covered by a protective shield. If replacement of the local oscillator tube becomes necessary, proceed as directed in the following steps:

(1) BE SURE TO TURN OPERATING POWER OFF. Remove the power input cable from the POWER INPUT receptacle at the rear of the Power Unit.

(2) Refer to figures 62 and 63 for proper identification of the local oscillator cavity.

(3) Loosen the single screw which clamps the protective shield to the right end of the oscillator cavity. Remove the shield so that the tube socket and cavity are accessible.

(4) Gently pull the tube socket assembly away from the base of the klystron tube.

(5) Use the spanner wrench to loosen the knurled collar at the end of the cavity and remove the collar completely on Bands 1 and 2. On Bands 3 and 4, merely loosen the collar a few turns. (With the klystron tube inserted in the oscillator cavity, the collar cannot be removed).

(6) Grasp the projecting end of the klystron tube, gently rotating it in a clockwise direction, whil simultaneously withdrawing the tube from the spring holders within the cavity.

NOTE

In removing the collar (from Bands 1 and 2), one spring and a retaining ring, mounted within the cavity, may also come out. Be sure to re-insert these components within the cavity. First, insert one spring; then follow with the retaining ring. Replace the collar by threading it approximately 1/2 turn on to the cavity. (In Bands 3 and 4, there are two retaining springs, between which is a small metal ring in addition to the retaining ring.)

c. REASSEMBLY PROCEDURE. To insert a replacement tube into the cavity, proceed as directed below:

(1) For Tuning Units covering Bands 3 and 4 only, mount the knurled collar on the oscillator housing, before inserting the klystron tube into the cavity.

(2) Gently push the klystron tube into the center of the cavity, and press it all the way in, against a noticable resistance. (This resistance is an indication that the inner conductors of the cavity are sliding over the collar at the end of the tube.) Continue pushing the tube into the cavity, giving the tube a slight clockwise twist, until it meets a positive stop, in the forward direction. (In Bands 3 and 4, two noticable resistances will be felt, due to the use of a retaining spring, before the tube is securely seated.)

(3) Retighten the knurled collar.

(4) Attach the socket assembly to the base of the replacement klystron tube.

NOTE

Carefully observe the arrangement of the four pins at the base of the tube and the mating connectors on the tube socket. Do not use excessive force in replacing the socket assembly on to the base of the tube. It is possible to insert the socket in a misaligned position. The klystron tube can be permanently damaged under this condition.

(5) Replace the protective shield over the protruding socket of the tube, and secure the shield to the cavity.

NOTE

On Bands 3 and 4, the closed ends of the slots (at the open end of the shield) should be over the knurled collar, with the shield clamp in its tightened position.

63. LOCAL OSCILLATOR REPELLER VOLTAGE TRACKING. (See figures 62, 63 and 76).

a. INTRODUCTION. Due to variations in klystron tube characteristics, replacement of the local oscillator tube within any one of the four Tuning Units will usually require readjustment of the repeller tracking voltages. To perform these adjustments, proceed as directed in the following steps:

(1) Rotate the AFC switch on the Monitor Unit front panel to the OUT position.

(2) Remove the coaxial cable from the output of the crystal mixer (located on the preselector-mixer housing), and remove the crystal diode from the housing. The crystal diodes used in each of the Tuning Units are listed below.

(a) Band 1 -- Type 1N23C, Symbol CR401;

(b) Band 2 -- Type 1N23C, Symbol CR501;

(c) Band 3 -- Type ~~1N286~~ IN2510, Symbol CR601;

(d) Band 4 -- Type ~~1N286~~ IN2510, Symbol CR701.

b. PROCEDURE.

(1) In place of the functioning crystal diode, substitute a dummy crystal, which has been purposely shorted out internally by removing the detecting element and filling the crystal housing with solder.

(2) Connect coaxial cable W415 in Band 1 to the output of the mixer, and connect the opposite end of cable W415 to a wavemeter covering the frequency range of the local oscillator, as shown in table XIII, section D. (Band 1 reference symbols are used as an example in this step.)

(3) Connect a crystal detector (having a dc return if the wavemeter in use is not provided with a dc return) to the output of the wavemeter.

(4) Connect the input of a high-gain oscilloscope across the crystal detector to chassis ground.

(5) With operating power still disconnected, set up the equipment for observing klystron oscillator mode patterns, as shown in figure 62.

(6) Be sure to connect leads from the reflector voltage modulation output transformer to the test point jacks located at the sides of each Tuning Unit chassis. (See figures 62 and 63.)

(7) Apply operating power to the instrument. After the beam supply is energized, check the voltages indicated on the Power Unit VOLTMETER. Readjust the screwdriver controls on the Power Unit front panel, if required, to obtain a proper voltmeter pointer deflection for the four positions of the VOLTMETER selector.

(8) Rotate the modulation amplitude control in the test setup (figure 67) to obtain a trace of the mode pattern on the scope screen.

(9) Rotate the front panel TUNING control until the local oscillator cam follower is at the fixed point of the adjustable cam, as identified in figure 68. Be sure to observe that the local oscillator cam is located close to the reflector potentiometers in the Tuning Units covering Bands 1 and 2, while the local oscillator cam is located close to the tuning dial in the Tuning Units covering Bands 3 and 4. (See table XX.)

TABLE XX. LOCATION OF LOCAL OSCILLATOR AND SIGNAL CALIBRATOR TUNING CAMS

Band	Local Oscillator Cam	
1	Directly above reflector potentiometers	Directly below tuning dial
2	Directly above reflector potentiometers	Directly below tuning dial
3	Directly below tuning dial	Directly above reflector potentiometers
4	Directly below tuning dial	Directly above reflector potentiometers

(10) Tune the wavemeter to obtain a scope indication of a dip in the center of the mode pattern. This dip indicates the true frequency of the local oscillator.

(11) Vary the klystron local oscillator COARSE FREQUENCY ADJ screw (shown in figure 62) to obtain an output frequency of the local oscillator 260 mc above the dial setting on Bands 1 and 2, but 260 mc below the tuning dial setting on Bands 3 and 4.

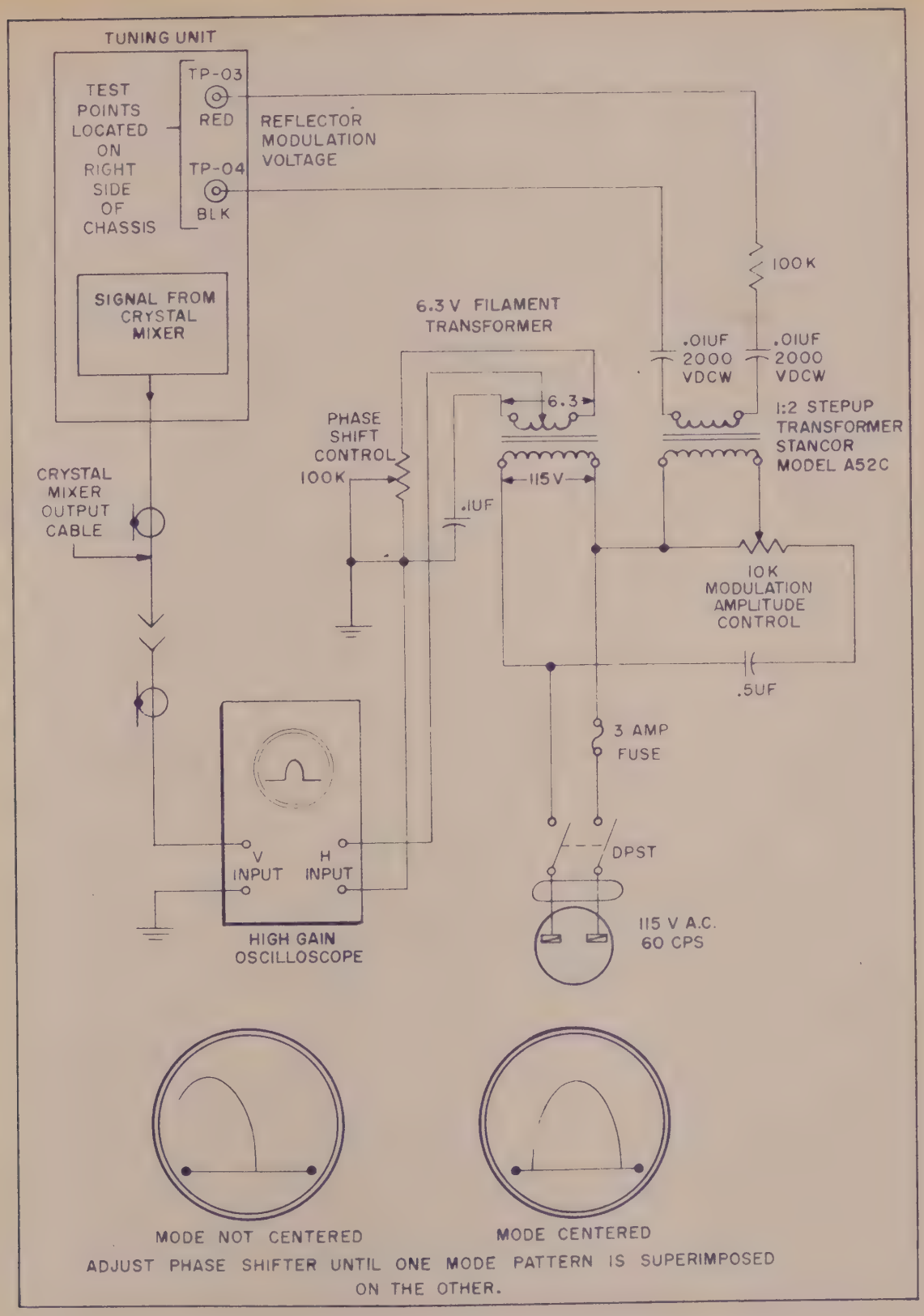


FIGURE 67 • TEST SET-UP FOR TRACKING MODE PATTERNS.

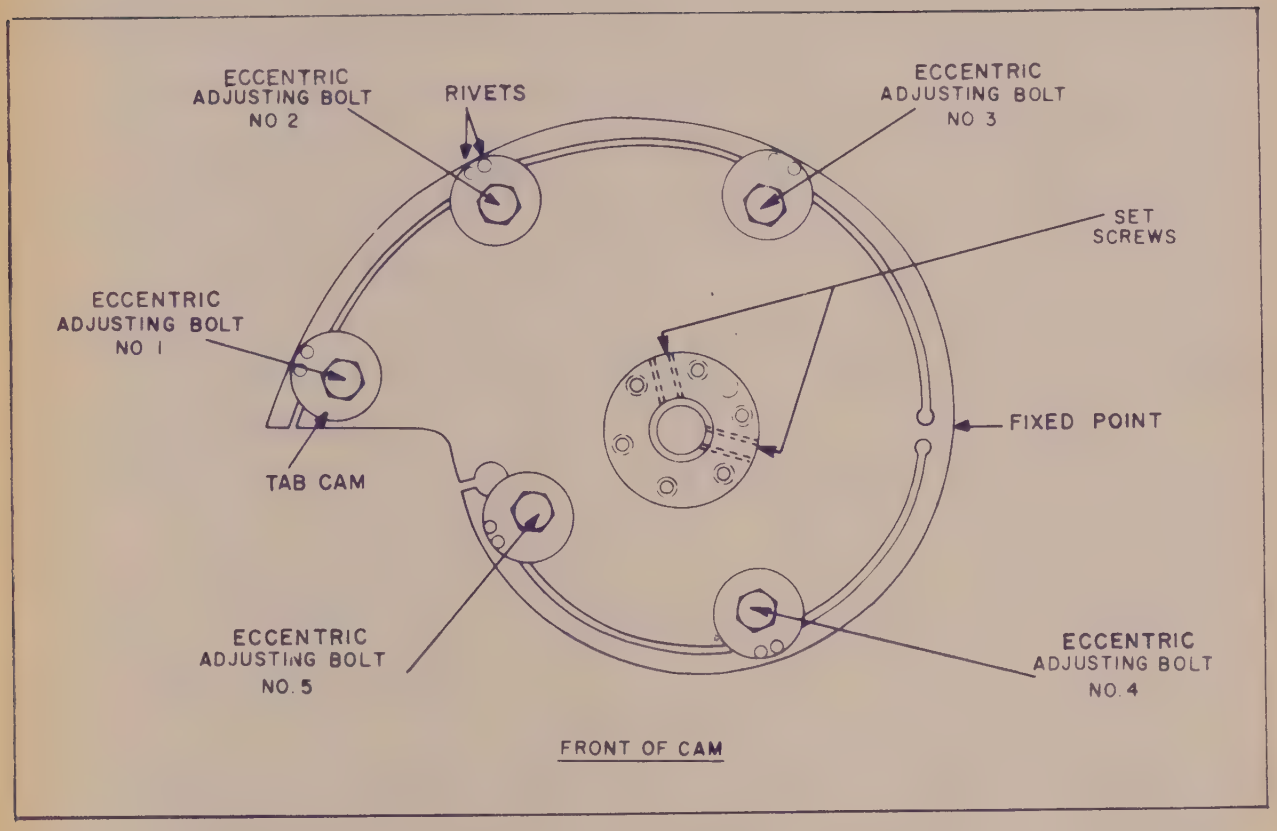


FIGURE 68. OSCILLATOR ADJUSTABLE TUNING CAM, COMPONENT LOCATION DIAGRAM

(12) A number of adjustment controls (one set for the local oscillator klystron and a second set for the signal calibrator) are accessible at the sides of each Tuning Unit chassis. (See figures 62 and 63.) Note that Bands 1 and 4 are provided with four controls for each oscillator, since mode switching occurs over the tuning range. On the other hand, Bands 2 and 3 are provided with only two adjustment controls for each oscillator, since there is no need for mode switching in these tuning ranges. Refer to table XXI for identification, by reference symbol, of the various adjustment controls.

TABLE XXI. IDENTIFICATION OF TUNING UNIT ADJUSTMENT CONTROLS

Designation				
	Band 1	Band 2	Band 3	Band 4
*L.O. LO MODE	R462	Not applicable	Not applicable	R762
L.O. HI MODE	R464	Not applicable	Not applicable	R764
L.O. LO	R461	R561	R662	R761
L.O. HI	R458	R558	R661	R758
*S.C. LO MODE	R446	Not applicable	Not applicable	R746
S.C. HI MODE	R433	Not applicable	Not applicable	R733
S.C. LO	R427	R527	R632	R727
S.C. HI	R431	R531	R631	R731

*Note: L.O. denotes local oscillator; S.C. denotes internal signal calibrator.

(13) If the mode is not centered, as shown in figure 67, proceed as directed in paragraphs 64 and 65 below.

64. BANDS 1 AND 4 TRACKING PROCEDURE, SPECIFIC INSTRUCTIONS.

a. To track Bands 1 and 4, proceed as follows:

(1) Rotate the tuning dial to below the mode switching point. Center the mode pattern by adjusting the L.O. LO MODE potentiometer (table XXI).

(2) Then tune to above the mode switching point. Center the mode pattern by adjusting the L.O. HI MODE potentiometer (table XXI).

(3) Then tune to the high end of the tuning dial and center the mode by adjusting the L.O. HI potentiometer (table XXI).

(4) Then tune to the low end of the tuning dial and center the mode by adjusting the L.O. LO potentiometer (table XXI).

(5) Due to some interaction between controls, it may be necessary to repeat the above procedure for optimum setting of the controls throughout the frequency range.

NOTE

At this point, remove the repeller voltage modulating test setup from the Tuning Unit (figure 67). Then check the local oscillator cathode current on the Power Unit KLYSTRON CATHODE CURRENT meter for proper value. (See table XVII.) Readjust the L.O. BIAS potentiometer, if necessary, to obtain the proper meter indication.

(6) Tune the local oscillator so that its cam follower points opposite each adjusting bolt on the tuning cam. (See figure [illegible].) Measure the frequency at each point. (Note the relationship of the local oscillator frequency to the tuning dial point, as shown in table XIII.)

(7) If frequencies at the tab cam points on the cam are more than ±2 percent off, the following fine frequency adjustments are then required:

CAUTION

NEVER ATTEMPT TO ADJUST ANY TAB ON THE TUNING CAM UNLESS ALL BOLTS ON THAT SECTION OF THE CAM ARE FIRST LOOSENED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING THE RIVETS THAT SECURE THE TAB CAMS TO THE CAM.

(a) First adjust the tab cams closest to the fixed point (figure 68) of the large cam. Then tighten tab cam No. 3, and proceed in this sequence:

2nd step: Eccentric No. 2

3rd step: Eccentric No. 1

4th step: Eccentric No. 4

5th step: Eccentric No. 5

(b) Readjusting the tab cams will shift the mode patterns slightly. Repeat the procedure of paragraph 63 to obtain the optimum setting of mode patterns.

(8) Remove the dummy crystal from the crystal mixer, and reinsert the proper crystal diode into the crystal mixer housing. Be sure to disconnect the modulating voltage circuit from the reflector of the klystron local oscillator.

(9) Reconnect the output of the crystal mixer to the input of the preamplifier.

(10) Rotate METER SELECTOR switch to the XTAL CUR position. Tune throughout the frequency range for an observable meter pointer deflection throughout the band. If there are points in the band

where an abrupt drop in crystal current is observed on the meter, readjustment of the probe in the local oscillator cavity will be required. Before this probe is secured in the pipe of the local oscillator cavity provided with a hex nut, the position of the probe must be optimized in both depth and orientation for maximum crystal current throughout the band.

65. PRESELECTOR ALIGNMENT

a. INTRODUCTION. Replacement of the klystron local oscillator tube will require realignment of the preselector. In Bands 1 and 2, the preselectors are aligned by a series of screws which are accessible from the top of the preselector cavity, as shown in figure 69. In Bands 3 and 4, a tape cam correcting device is utilized for aligning the preselector. If preselector alignment is required, proceed as directed in the following steps:

b. PRESELECTOR ALIGNMENT, BAND 1.

(1) Remove the plate from the end of the preselector cavity.

(2) All preselectors adjustment screws should be retracted from the inside of the preselector cavity and aligned flush with the inside wall. Figure 69 illustrates the preselector rods and the fine adjustment screws.

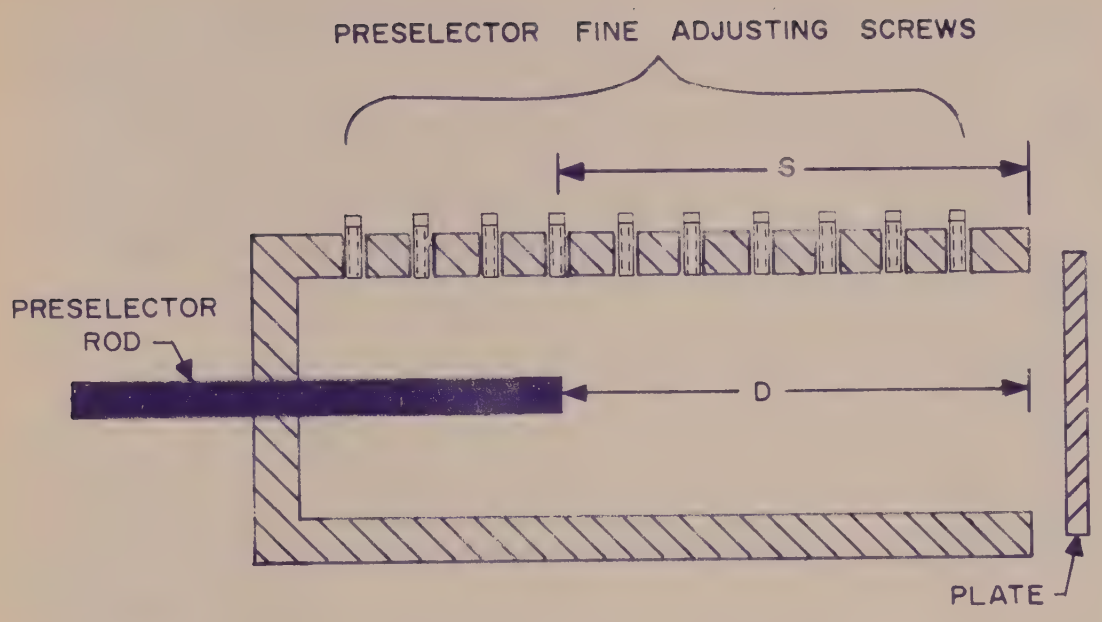


Figure 69. Preselector Cavity, Sectional Side View (Band 1)

(3) Rotate the frequency dial to the high end of Band 1 and adjust the signal from the generator for maximum output.

(4) Adjust the two preselector coarse adjustment screws (see figure 62) for a maximum indication on the output meter.

(5) With the use of a vernier caliper, measure the distance from the tip of the preselector rods to the outside of the cavity.

(6) Using the vernier calipers, find the distance (S in figure 69) from the screw nearest the tip of the preselector rods, to the end of the cavity casting.

(7) Rotate the frequency knob so that the distance from the tip of the preselector rod to the end of the cavity casting (D in figure 69) will be equal to the distance S as determined in step 6.

(8) Peak up the input signal and adjust the two preselector fine adjustment screws at this position for maximum output.

(9) With the aid of the calipers, go from the high end to the low end of the tuning dial and measure and adjust the screws at the points where the preselector rod tips are directly below the screws.

(10) The procedure for aligning the preselector should be repeated two or three times and then the sensitivity should be better than -81 dbm. If the sensitivity is low between adjustment screw points, the screws may have to be slightly readjusted.

(11) After the preselector has been satisfactorily aligned, the plate that is attached to the end of the preselector casting should be installed.

c. PRESELECTOR ALIGNMENT, BAND 2.

The alignment of the Band 2 preselector is the same as that for Band 1, except that the preselector fine adjustment screws should be screwed into the preselector cavity, so that the top of the screw is flush with the outer wall of the cavity.

d. PRESELECTOR ALIGNMENT, BANDS 3 AND 4.

(1) Place a small mirror, about 3 inches by 5 inches surface area, so that one of rollers on the preselector correcting mechanism is visible. Two rollers, side by side, are located directly beneath the sliding platform which contains the fine screw adjustments. Each pair of set screws is to be adjusted,

but only when the preselector correcting mechanism rollers are directly beneath the appropriate screws. The mirror will facilitate observing the position of the rollers along the tape travel.

(2) Adjust the two screws (one for each tape cam) to obtain a peaked indication on the OUTPUT METER. Decrease the signal calibrator output, if necessary, to maintain an on-scale pointer deflection throughout the adjustment procedure.

(3) Repeat this step for each set of screws along the preselector sliding platform.

NOTE

It may be found that there is insufficient range of adjustment at certain points in the frequency range. For example, at some points in the frequency range, more or less penetration than can be made with the screw may be desired. If this condition exists, reset the two coarse adjustment screws (figure 62) so that all fine tuning screws fall within the range of the tuning cam.

66. SIGNAL CALIBRATOR, ALIGNMENT.

a. INTRODUCTION. After replacement of the signal calibrator klystron oscillator tube, frequency and mode realignment of the circuit is required. Proceed as follows:

NOTE

The techniques employed are identical to those outlined above for alignment of the local oscillator, except for the specific differences listed below.

(1) The frequency of the oscillator is identical to that engraved on the tuning dial.

(2) The reflector modulation voltage is applied to TP-01 and TP-02, located at the side of the Tuning Units, instead of to TP-03 and TP-04. (Substitute the applicable series of referenc symbols for the Tuning Unit, in lieu of the dash (-) above.)

(3) The r-f power, which is to be applied to the wavemeter, is available at either connector P122 or at P135, the input to the r-f attenuator assembly. (No dummy crystal is required, as in local oscillator alignment.)

(4) The "function selector" must be rotated to CALIBRATE position.

(5) The Power Unit KLYSTRON CATHODE CURRENT selector must be rotated to SIGNAL CALIBRATOR position.

(6) The amount of r-f power applied to the wavemeter can be varied by rotation of the Tuning Unit SIGNAL CALIBRATOR OUTPUT ATTENUATOR control.

(7) Rotate the SIGNAL CALIBRATOR FINE TUNING and SIGNAL CALIBRATOR COARSE TUNING controls to their mid-positions.

(8) The SIGNAL CALIBRATOR POWER SET control on the Tuning Unit panel should best be rotated completely counterclockwise throughout the alignment procedure.

67. SIGNAL CALIBRATOR OUTPUT ATTENUATOR, ADJUSTMENTS.

a. PURPOSE. This adjustment is performed to minimize the error of the output attenuator due to the fact that its characteristics differ slightly from the characteristics of thermistor RT-03. Thermistor RT-03 is varied in position, within the signal calibrator cavity, by the SIGNAL CALIBRATOR POWER SET control.

b. REQUIRED TEST EQUIPMENT.

(1) A bolometer, such as Polytechnic Research Model 627A (or equivalent).

(2) A Universal Power Bridge, such as Polytechnic Research Model 650A (or equivalent).

(3) A slide rule or conversion tables equating power ratios to db, and db to power ratios.

c. PROCEDURE. Before proceeding with the alignment of the output attenuator, make sure that both the thermistor probe and attenuator probe ground sections are facing toward the klystron tube socket. To align the output attenuator, proceed as follows:

(1) Rotate the function switch, on the Monitor Unit front panel to ZERO SET position.

(2) Place the METER SELECTOR switch in the POWER MON position.

(3) Rotate the ZERO SET control to its maximum clockwise position.

(4) Adjust the COARSE bridge adjustment, on the right side of the Tuning Unit, so that the POWER MONITOR METER reads full scale deflection.

(5) Adjust the ZERO SET control for a reading of zero on the POWER MONITOR METER.

(6) Set the function selector switch to CAL SIG GEN position.

(7) Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR and the POWER SET controls completely counterclockwise.

(8) Connect the Power Bridge, using a Bolometer mount to the signal generator attenuator output.

(9) Turn the frequency dial to the low end of the band, and rotate the POWER SET control fully clockwise so that the maximum power is fed into the POWER MONITOR METER.

(10) Loosen the two set screws holding the thermistor yoke to the power monitor drive and adjust the position of the thermistor assembly so that when the POWER SET control is fully clockwise, the POWER MONITOR METER will indicate full scale deflection.

(11) Retighten the two set screws.

CAUTION

Care should be exercised so as not to damage the hats on Bands 1 and 3. If the hats are bent or damaged in any way, the frequency alignment will be void.

(12) Rotate the frequency dial throughout the range and ensure that the POWER SET control can be varied above and below CAL.

(13) Set the frequency dial to the low end of the band.

(14) Balance the bridge for a zero set indication.

(15) Rotate the SIGNAL CALIBRATOR POWER SET control, with the METER SELECTOR switch in the POWER MON position, to obtain a CAL indication on the POWER MONITOR METER.

(16) Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control in a clockwise direction to obtain a reading at approximately mid-scale using the low range of the power bridge.

(17) Note the reading of the attenuator dial. This reading will be used as a reference point.

(18) Rotate the tuning dial in a clockwise direction, to increase the frequency very slowly. At the same time, observe both the variation in pointer deflection on the POWER MONITOR METER and on the Universal Power Bridge. Look for the following type of variation, in this procedure, in order to determine the points at which further readings will be required:

(a) Where the POWER MONITOR METER pointer deflects to a peak, while the Universal Power Bridge pointer deflects to a trough.

(b) Where the POWER MONITOR METER deflects to a trough, while the Universal Power Bridge deflects to a peak.

(c) Where the pointer on the Universal Power Bridge deflects to a peak or trough, even though the POWER MONITOR METER pointer does not change direction.

(d) Where the pointer on the POWER MONITOR METER deflects to a peak or trough, even though the pointer on the Universal Power Bridge does not change direction.

(19) At points where data is to be taken, re-zero both the Power Monitor Bridge and the Universal Bridge.

(20) Set CAL and attenuator at the reference point (step 17) on the attenuator dial and record the reading.

(21) If there are no peaks and troughs indicated, or if a large frequency difference between peaks and troughs are noted then data should be taken at various points throughout the frequency range.

(22) Find the frequency at which (for a CAL pointer deflection on the power monitor meter) the largest power indication is observed on the universal power bridge. Note this frequency as F_1, and this power indication as P_1 mw.

(23) Find the frequency at which (for a CAL setting on the power monitor meter) the lowest power indication is observed on the universal power bridge. Note this frequency as F_2, and this power indication as P_2 mw.

(24) The settings on the attenuator dial at F_1 and F_2 must be the same, but at some point which will not drive the pointer on the universal power bridge off-scale.

(25) The total db error is $ndb = 10 \log_{10} \frac{P_1}{P_2}$

(26) If the total db error is greater than 5 db, replacement of the thermistor probe may be required. Assuming that the error is less than 5 db, proceed with the following steps:

(a) Divide the total db error by two, i, e.,

$$\frac{ndb}{2} = 10 \log_{10} \frac{P'_1}{P'_2}$$

where P'_1 = 1 milliwatt

and P'_2 = Power out at F_2, with attenuator at a setting of zero db <u>after</u> the attenuator dial is readjusted.

Therefore, $P'_2 = 10^{\frac{-ndb}{20}} = \frac{1}{\log^{-1} \frac{ndb}{20}}$

(27) Rotate the frequency dial to F_2.

(28) Remove the SIGNAL CALIBRATOR OUTPUT ATTENUATOR and POWER SET knobs.

(29) Remove the two pilot lamps from the attenuator dial cover.

(30) Remove the screw, located between the two control shafts, which secure the attenuator dial cover to the panel.

(31) Now to reset the attenuator dial, loosen the two set screws holding the attenuator dial to the drive shaft.

(32) Set the POWER MONITOR to CAL position.

(33) Insert the attenuator probe to the value of the low power point (P'_2) calculated previously.

(34) Slip the attenuator dial so the 0dbm lines up with the hairline of the POWER SET window.

(35) Tighten both set screws.

(36) Zero set the power monitor bridge and reset CAL and set attenuator dial to 0dbm.

(37) Check to see that the reading on the universal power bridge is the same as that calculated in step 26 for low power point (P'_2).

(38) A check of power throughout the frequency band at CAL and 0dbm should indicate that the power is centered about 1 mw. If at any point, the attenuator dial will not read 0dbm at CAL, the stops on the attenuator assembly will require resetting.

SECTION F

SUPPLEMENTARY DATA

68. SCOPE OF SECTION.

a. CALIBRATION CURVES. Included within this section of the handbook are typical calibration curves for use with the four directive antennas (one for each Tuning Unit) and the omni-directional broadband antenna (for use with any of the Tuning Units for omnidirectional reception). The following correction curves for each model of the FIM can be found in the envelope on the rear cover of this instruction book:

1) Curves of Actual Attenuation of Tuning Unit Input Attenuators.

2) Error of Tuning Unit Signal Calibrator Output Attenuators.

b. VOLTAGE AND RESISTANCE MEASUREMENTS. As a further aid to maintaining the equipment at peak performance, three charts of voltage and resistance measurements are supplied in this section of the handbook, as follows:

1) Table XXII is a listing of voltage measurements taken with a 20,000 ohm-per-volt meter.

2) Table XXIII is a listing of voltage measurements taken with a 1,000 ohm-per-volt meter.

3) Table XXIV is a listing of resistance measurements from tube socket pins to chassis ground.

69. CALIBRATION CURVES I and II.

a. The data shown in curves I and II are based on a reading of 10 microvolts on the OUTPUT METER, located on the Monitor Unit panel.

b. If the reading on the OUTPUT METER is 56 microvolts, the multiplication factor is $\frac{56}{10}$, or 5.6 times the reading on the applicable curve -- depending on the antenna in use and the frequency of reception.

c. An example of the use of the curves is given below:

1) Assume a signal is received at 1,600 mc, with 40 db of attenuation, and with the applicable directive antenna in use. Under these conditions, the pointer on the OUTPUT METER deflects to 36 microvolts.

2) Refer to curve I, directly above 1.6 kmc, on the frequency abscissa.

3) Observe the point of intersection of the applicable curve against the microvolts/meter ordinate.

4) In this example, 150 microvolts/meter coincides with 1.6 kmc, when the Band 1 directive antenna is used with the six-foot RG-9A/U cable.

5) To obtain the correction factor, bear in mind that 40 db corresponds to a voltage factor of 10^2.

6) A meter indication of 36 microvolts is equivalent to a voltage factor of $\frac{36}{10}$, or 3.6.

7) Therefore, the total correction factor is equal to 360.

8) On this basis, the corrected field intensity indication is the product of 360 x 150 microvolts/meter, which is equal to 54 millivolts/meter.

70. CORRECTION CURVES.

a. An example of the use of the correction curve of Actual Attenuation of the Tuning Unit Input Attenuators is given below:

1) Assume a signal is received at 1,600 mc, with the INPUT ATTENUATOR switch in the 40 db x 100 position. The pointer on the OUTPUT METER deflects to 50 microvolts.

2) Refer to the curve of Actual Attenuation of Tuning Unit Input Attenuator (in this case it would be the Band 1 Curve), directly above the 1.6 kmc, on the frequency abscissa.

3) Note the point of intersection with the applicable attenuation position. In our example, with the 40 db x 100 position line.

4) Let us assume that the point of intersection reads 46 db. This means that the signal is being attenuated by 46 db instead of 40 db, or a difference of +6 db.

5) The voltage multiplication factor of 100 is incorrect for our example, and a new voltage multiplication factor has to be determined, as outlined below:

a) Refer to Table XXV, read directly across the +6 db line in order to find the proper voltage ratio number. In this case, the

number is 2.

b) Multiply the voltage ratio number by the multiplication factor number, ex. 2 x 100 = 200.

c) The result of 200 is the new voltage multiplication factor number.

6) Therefore, the corrected microvolt reading is the product of 50 microvolts x 200, which is equal to .01 volts.

b. In order to accurately calibrate the FIM with the Error of Tuning Unit Signal Calibrator Output Attenuator Curves, proceed in the following manner:

1) After zero-setting the POWER MONITOR meter, rotate the FUNCTION SELECTOR switch to the CAL. SIG. GEN. position.

2) Vary the setting of the SIGNAL CALIBRATOR POWER SET control, to obtain a pointer deflection on the POWER MONITOR meter as determined by the Error of Tuning Signal Calibrator Curve. For example: Assume a signal is received at 2.500 kmc, refer to the Error of Tuning Signal Calibrator Output Attenuator Curve for Band 2. Note the point of intersection between the 2.500 kmc, on the frequency abscissa and the db error ordinate. Let us assume that this point reads -1.5 db. Vary the setting of the SIGNAL CALIBRATOR POWER SET control until the pointer on the POWER MONITOR meter is directly over the +1.5 db mark.

3) Proceed to calibrate the FIM as outlined in Section C of the instruction manual.

TABLE XXII. VOLTAGE MEASUREMENTS TAKEN WITH 1,000 OHM-PER-VOLT METER

All voltages are dc, unless otherwise noted, and are measured to chassis ground.

TUBE	PIN NUMBER								
	1	2	3	4	5	6	7	8	9
A. I-F AMPLIFIER									
V1	0	+1.75	6 ac	0	+110	+105	+1.75	-	-
V2	0	+1.75	6 ac	0	+105	+100	+1.75	-	-
V3	0	+1.75	6 ac	0	+105	+ 95	+1.75	-	-
V4	0	+1.875	6 ac	0	+115	+ 95	+1.875	-	-
V5	0	+2.25	6 ac	0	+115	+110	+2.25	-	-
V6	0	+2.25	6 ac	0	+115	+110	+2.25	-	-
V7	0	+2.0	6 ac	0	+105	+125	+2.0	-	-
V8	0	+6.0	6 ac	0	+125	+125	+6.0	-	-
V9	+0.625	0	6 ac	0	+0.125	0	0	-	-
V10	+0.25	0	+3	6 ac	6 ac	+125	0	3	0
B. AFC I-F AMPLIFIER									
V11	0	+1.0	6 ac	0	+125	+125	+1.0	-	-
V12	0	+1.0	6 ac	0	+125	+125	+1.0	-	-
V13	0	0	6 ac	0	+17.5	+ 60	0	-	-
V14	0	0	6 ac	0	+ 40	+ 42	0	-	-
V15	0	+1.0	0	6 ac	+125	+125	+1.0	-	-
V16	0	+1.0	0	6 ac	+115	+115	+1.0	-	-
C. CRYSTAL-CONTROLLED LOCAL OSCILLATOR									
V17	+125	3	+1.25	0	0	+125	+1	+1	6 ac
V18	-.25	+1.25	6 ac	0	+1[illegible]	+115	+2.25	-	-
V19	-4.0	+2.0	6 ac	0	+125	+115	+2.0	-	-
[illegible]	-4.5	+2.25	6 ac	0	+125	+105	+2.25	-	-

TABLE XXII. VOLTAGE MEASUREMENTS TAKEN WITH 1,000 OHM-PER-VOLT METER (cont'd)

TUBE	PIN NUMBER								
	1	2	3	4	5	6	7	8	9
D. MONITOR UNIT CIRCUITS									
V21	+125	+ 25	+ 30	6 ac	6 ac	+125	+ 25	+ 30	0
V22	0	+1.25	6 ac	0	+ 25	+ 0	+1.25	-	-
V23	+110	+110	6 ac	0	0	0	+1.5	-	-
V24	+110	+110	6 ac	0	0	0	+1.75	-	-
V25	+ 25	0	+0.25	6 ac	6 ac	0	0	0	0
V26	0	+ 25	0	6 ac	+100	+105	0	-	-
E. POWER UNIT									
V301	0	+320	0	265 ac	0	250 ac	+320	-	-
V302	0	-5	0	-325	0	-325	0	-	-
V303	- 85	+250	- 25	0	- 85	-	-	-	-
V304	0	- 85	0	-85	0	-90	- 85	-	-
V305	- 85	-175	- 75	-175	- 85	-75	-175	-	-
V306	- 25	- 90	- 85	-85	- 85	-90	-175	-175	-85
V307	100 ac	0	2 ac	2 ac	0	100 ac	0	-	-
V308	0	+250	0	-500	0	-500	+215	-	-
V309	0	-475	0	-1150	0	-1150	-475	-	-
V310	- 25	- 25	- 25	- 25	+250	+250	- 25	-	-
V311	-1150	-325	-1150	-1150	- 25	- 25	-370	-	-
V312	-1150	-1150	-1150	-1150	-1150	-1150	-500	-500	-1150
V313	-1150	-1150	-1150	-1150	-325	-300	-1325	-	-
V314	-1150	-1150	-1150	-1150	-1150	-1150	-1150	-	-
V315	-1150	-1150	-1150	-1150	-1150	-1150	-1150	-	-
V316	-1150	-1150	-1075	-1150	-1025	-1000	-1150	-	-
V317	0	+320	0	320 ac	0	320 ac	0	+320	-
V318	0	+320	0	320 ac	0	320 ac	0	+320	-
V319	+215	+110	0 ac	0 ac	0	+270	0 ac	-	-
V320	+215	+	+320	+265	+250	+130	-	-	-
V321	0	+	+320	+265	+215	+130	-	-	-
V322	0	0	0	0	0	0	-	-	-
V323	0	0	-1250	-1150	- 75	+	-	-	-
V324	+125	0	0	0	+125	0	-	-	-

TABLE XXII. VOLTAGE MEASUREMENTS TAKEN WITH 1,000 OHM-PER-VOLT METER (cont)

F. PREAMPLIFIER			
TUBE	TUBE ELEMENT		
	CATHODE	PLATE	
V301	+0.5	+120	
V302	+0.5	+120	

TABLE XXIII. VOLTAGE MEASUREMENTS TAKEN WITH 20,000 OHM-PER-VOLT METER

All voltages are dc, unless otherwise noted, and are measured to chassis ground.

TUBE	PIN NUMBER								
	1	2	3	4	5	6	7	8	9
A. I-F AMPLIFIER									
V1	0	+1.7	6 ac	0	+110	+102	+1.7	-	-
V2	0	+1.6	6 ac	0	+107	+100	+1.6	-	-
V3	0	+1.75	6 ac	0	+105	+95	+1.75	-	-
V4	0	+1.82	6 ac	0	+105	+98	+1.85	-	-
V5	0	+2.3	6 ac	0	+110	+102	+2.3	-	-
V6	0	+2.3	6 ac	0	+110	+102	+2.3	-	-
V7	0	+2.1	6 ac	0	+105	+225	+2.1	-	-
V8	0	+6.2	6 ac	0	+105	+120	+6.2	-	-
V9	+0.85	0	6 ac	0	+[illegible]	0	0	-	-
V10	+1[illegible]	[illegible]	+2[illegible]	6 ac	6 ac	+120	[illegible]	3	

TABLE XXIII VOLTAGE MEASUREMENTS TAKEN WITH 20,000-OHM-PER-VOLT METER (cont.)

All voltages are dc, unless otherwise noted, and are measured to chassis ground.

TUBE	PIN NUMBER								
	1	2	3	4	5	6	7	8	9
B. AFC I-F AMPLIFIER									
V11	0	0.95	6 ac	0	+125	+125	+0.95	-	-
V12	0	+1.1	6 ac	0	+125	+125	+1.1	-	-
V13	0	0	6 ac	0	+17	+3	0	-	-
V14	0	0	6 ac	0	+39	+42.5	0	-	-
V15	0	+1.05	0	6 ac	+125	+125	+1.05	-	-
V16	0	+0.85	0	6 ac	+115	+115	+0.85	-	-
C. CRYSTAL-CONTROLLED LOCAL OSCILLATOR									
V17	+125	0	+1.35	0	[illegible]	+125	+1	+1	6 ac
V18	-0.2	+2.25	6 ac	0	+125	+115	+2.25	-	-
V19	-4	+1.9	6 ac	0	+125	+105	+1.95	-	-
V20	-6.4	+2.2	6 ac	0	+125	+125	+2.25	-	-
D. MONITOR UNIT CIRCUITS									
V21	+125	+23	+31	6 ac	6 ac	+125	+23	+31	0
V22	0	+1.35	6 ac	0	+23	+41	+1.35	-	-
V23	+107	+107	6 ac	0	0	0	+1.5	-	-
V24	+107	+107	6 ac	0	0	0	+1.75	-	-
V25	+45	0	+0.7	6 ac	6 ac	0	0	0	0
V26	-	+45	-	6 ac	+100	+105	0	-	-

TABLE XXIII VOLTAGE MEASUREMENTS TAKEN WITH 20,000 OHM-PER-VOLT METER (cont)

TUBE	PIN NUMBER								
	1	2	3	4	5	6	7	8	9
E. POWER UNIT									
V201	0	+320	0	265 ac	0	250 ac	+320	-	-
V202	0	-5	0	-325	0	-325	0	-5	-
V203	-85	+280	-22	0	-85	-	-	-	-
V204	0	-85	0	-85	0	-20	-85	-	-
V205	-97	-175	-75	-175	-85	-77	-175	-	-
V206	-22	-90	-85	-85	-87	-89	-175	-173	-86
V207	100 ac	0	2 ac	2 ac	0	100 ac	0	-	-
V208	0	+220	0	-490	0	-490	+215	-	-
V209	0	-470	0	-1170	0	-1170	-480	-	-
V210	-30	-25	-25	-24	+240	+240	-25	-	-
V211	-345	-325	-410	-410	-23	-25	-345	-	-
V212	-380	-410	-410	-410	-410	-410	-500	-500	-410
V213	-325	-420	-310	-410	-325	-310	-420	-	-
V214	-420	-490	-490	-500	-420	-490	-490	-	-
V215	-910	-1020	-840	-1020	-910	-830	-1020	-	-
V216	-1020	-1160	-1020	-1160	-1020	-980	-1160	-	-
V217	0	+340	0	420 ac	0	420 ac	0	+340	-
V218	0	+340	0	420 ac	0	420 ac	0	+340	-
V219	-570	-167	80 ac	77 ac	0	-570	440 ac	-	-
V220	+57	+285	+132	+57	+287	+130	-325	-325	-
V221	+57	+285	+132	+57	+287	+130	-325	-325	-
V222	0	0	0	-105	0	0	-105	-	-
V223	0	0	-325	-325	+55	+45	0	-	-
V224	+105	0	0	0	+105	0	0	-	-

F. PREAMPLIFIER

TUBE	TUBE ELEMENT	
	CATHODE	PLATE
V301	+0.5	+120
V302	+0.45	+120

TABLE XXIV RESISTANCE MEASUREMENTS

All measurements are to chassis ground.

TUBE	PIN NUMBER								
	1	2	3	4	5	6	7	8	9
A. I-F AMPLIFIER									
V1	10 meg	200	.2	0	25 K	35 K	200	-	-
V2	0	200	.2	0	25 K	35 K	200	-	-
V3	0	200	.2	0	20 K	34 K	200	-	-
V4	0	300	.2	0	24 K	50 K	300	-	-
V5	7.5 meg	300	.2	0	24 K	30 K	300	-	-
V6	10 meg	300	.2	0	25 K	30 K	300	-	-
V7	0	250	.2	0	22 K	27 K	250	-	-
V8	0	150	.2	0	20 K	20 K	150	-	-
V9	500	0	.2	0	6.4 K	0	INF.	-	-
V10	20 K	550 K	10 K	.2	.2	20 K	550 K	10 K	0
B. AFC I-F AMPLIFIER									
V11	2 K	100	.2	0	9 K	9 K	100	-	-
V12	6 K	100	.2	0	9 K	9 K	100	-	-
V13	11 K	0	.2	0	30 K	9.5 K	0	-	-
V14	15 K	0	.2	0	30 K	9.5 K	0	-	-
V15	4.8 K	100	0	.2	9 K	9 K	100	-	-
V16	4.8 K	100	0	.2	10 K	10 K	100	-	-
C. CRYSTAL CONTROLLED LOCAL OSCILLATOR									
V17	20 K	14 K	200	[illegible]	[illegible]	[illegible] K	[illegible]	250	7.3
V18	20 K	200	.2	0	20 K	34 K	200	-	-
V19	34 K	200	.2	0	[illegible] K	[illegible] K	200	-	-
V20	20 K	200	.2	0	[illegible] K	[illegible] K	200	-	-

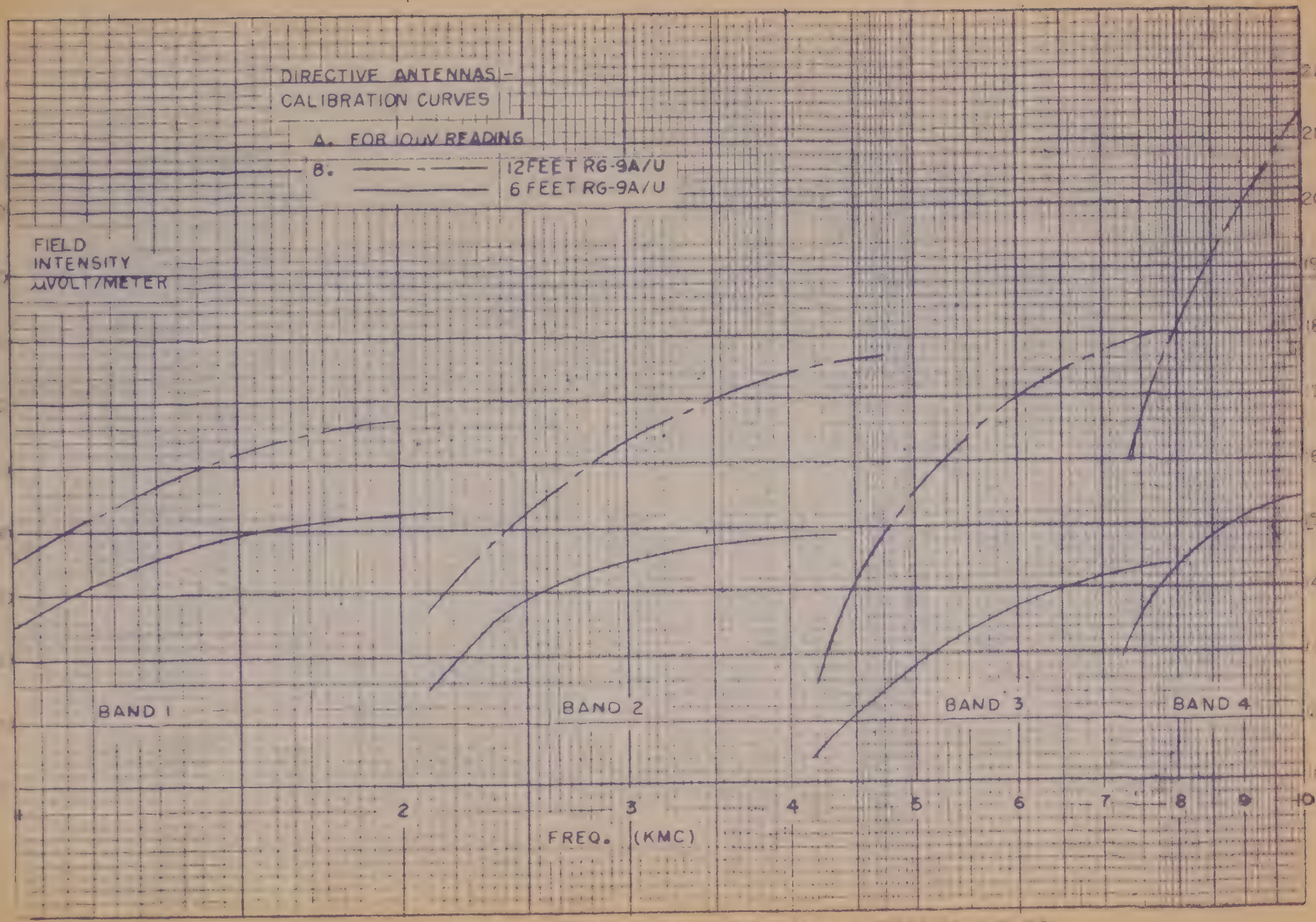
TABLE XXIV RESISTANCE MEASUREMENTS (cont)

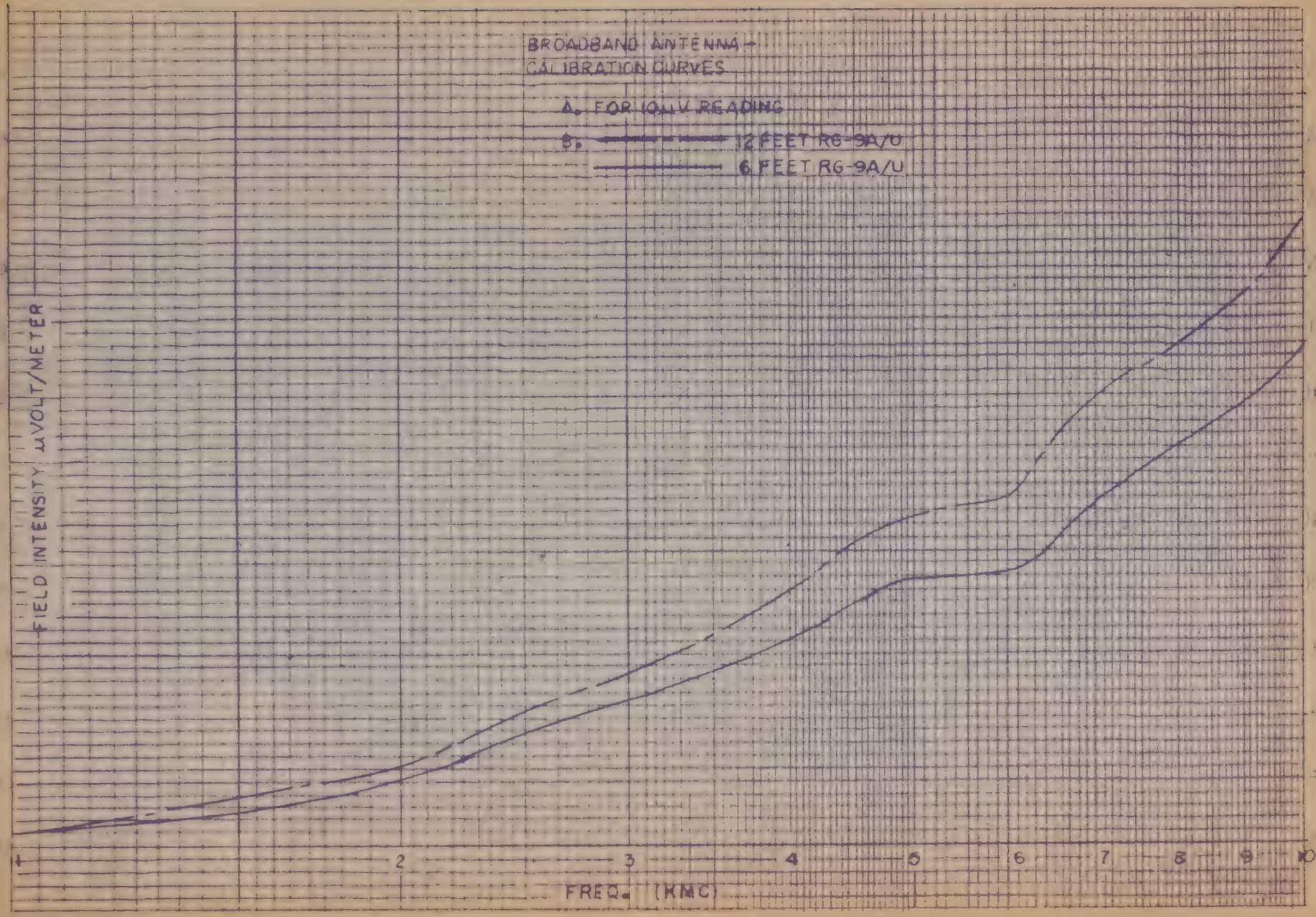
TUBE	PIN NUMBER								
	1	2	3	4	5	6	7	8	9
D. MONITOR UNIT CIRCUIT									
V1	[illegible] K	[illegible] K	[illegible] K	[illegible]	0.2	[illegible] K	[illegible] K	[illegible] K	0
V2	[illegible] K	[illegible] K	[illegible]	[illegible]	[illegible] K	[illegible] K	[illegible] K	-	-
V3	[illegible] K	[illegible] K	0.2	0	5 meg	5 meg	115 K	-	-
V4	24 K	[illegible] K	0.2	0	0	0	115 K	-	-
V5	65 K	[illegible] K	300	0.2	0.2	INF.	INF.	INF.	0
V6	[illegible] K	500	0	0.2	25 K	25 K	450 K	-	-
E. [illegible] UNIT									
V201	INF.	INF.	INF.	INF.	INF.	INF.	INF.	INF.	-
V202	INF.	INF.	INF.	INF.	INF.	INF.	INF.	INF.	-
V203	INF.	0.18 M	0.15 M	0	INF.	-	-	-	-
V204	0	INF.	INF.	INF.	0	INF.	INF.	-	-
V205	INF.	INF.	INF.	INF.	INF.	INF.	INF.	-	-
V206	0.15 M	68 K	INF.	INF.	INF.	68 K	INF.	INF.	INF.
V207	0.18 M	INF.	3	2	INF.	0.19 M	0	-	-
V208	INF.	INF.	INF.	INF.	INF.	INF.	INF.	INF.	-
V209	INF.	INF.	INF.	INF.	INF.	INF.	INF.	INF.	-
V210	INF.	INF.	INF.	INF.	INF.	INF.	INF.	-	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-
V212	INF.	INF.	INF.	INF.	INF.	INF.	INF.	INF.	INF.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-
V214	INF.	INF.	INF.	INF.	INF.	INF.	INF.	-	-
V215	INF.	INF.	INF.	INF.	INF.	INF.	INF.	-	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-
V217	INF.	0.18 M	INF.	52	INF.	52	INF.	0.18 M	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-
V220	0.53 M	0.18 M	INF.	0.53 M	0.18 M	INF.	INF.	INF.	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
[illegible]	0	INF.	INF.	INF.	0	INF.	INF.	INF.	-
[illegible]	INF.	0	INF.	INF.	0.53 M	30 K	0	-	-

TABLE XXIV RESISTANCE MEASUREMENTS (cont)

F. PREAMPLIFIER

TUBE	TUBE ELEMENT		
	CATHODE	PLATE	
V801	53	20 K	
V802	56	22 K	


DIRECTIVE ANTENNAS -
CALIBRATION CURVES
A. FOR 10 μV READING
B. 12 FEET RG-9A/U
6 FEET RG-9A/U
FIELD
INTENSITY
μVOLT/METER
220
210
200
190
180
70
60
50
40
30
20
10
BAND 1
BAND 2
BAND 3
BAND 4
2
3
4
5
6
7
8
9
10
FREQ. (KMC)



CURVE II. BROADBAND ANTENNA CALIBRATION CURVES

TABLE XXV . RELATION OF DB TO VOLTAGE RATIO

Db	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
+0	1.00	1.01	1.02	1.04	1.05	1.06	1.07	1.08	1.10	1.11
-0	1.00	.989	.977	.966	.955	.944	.933	.923	.912	.902
+1	1.12	1.14	1.15	1.16	1.18	1.19	1.20	1.22	1.23	1.24
-1	.891	.881	.871	.861	.851	.841	.832	.822	.813	.804
+2	1.26	1.27	1.29	1.30	1.32	1.33	1.35	1.37	1.38	1.40
-2	.794	.785	.776	.767	.759	.750	741	.733	.724	.716
+3	1.41	1.43	1.45	1.46	1.48	1.50	1.51	1.53	1.55	1.57
-3	.708	.700	.692	.684	676	.668	.661	.653	646	.638
+4	1.58	1.60	1.62	1.64	1.66	1.68	1.70	1.72	1.74	1.76
-4	.631	.624	.617	.610	.603	.596	.589	.582	.575	.569
+5	1.78	1.80	1.82	1.84	1.86	1.88	1.91	1.93	1.95	1.97
-5	.562	.556	.550	.543	.537	.531	.525	.519	.513	.507
+6	2.00	2.02	2.04	2.07	2.09	2.11	2.14	2.16	2.19	2.21
-6	.501	.495	.490	.484	.479	.473	.468	.462	.457	.452
+7	2.24	2.26	2.29	2.32	2.34	2.37	2.40	2.43	2.46	2.49
-7	.447	.442	.437	.432	.427	.422	.417	.413	.407	.403
+8	2.51	2.54	2.57	2.60	2.63	2.66	2.69	2.72	2.75	2.78
-8	.398	.394	.389	.385	.380	.376	.372	.367	.363	.359
+9	2.82	2.85	2.88	2.92	2.95	2.99	3.02	3.05	3.09	3.13
-9	.355	.351	.347	.343	.339	.335	.331	.327	.324	.320
+10	3.16	3.20	3.24	3.27	3.31	3.35	3.39	3.43	3.47	3.51
-10	.316	.313	309	.305	.302	.298	.295	.292	.288	.285
+11	3.55	3.59	3.63	3.67	3.72	3.76	3.80	3.85	3.89	3.94
-11	.282	.279	.275	.272	.269	.266	.263	.260	.257	.254
+12	3.98	4.03	4.07	4.12	4.17	4.22	4.27	4.32	4.37	4.42
-12	.251	.249	.245	.243	.240	.237	.234	.232	.229	.226
+13	4.47	4.52	4.57	4.62	4.68	4.73	4.79	4.84	4.90	4.95
-13	.224	.221	.219	.216	.214	.211	.209	.207	.204	.202
+14	5.01	5.07	5.13	5.19	5.25	5.31	5.37	5.43	5.50	5.56
-14	.200	.197	.195	.193	.191	.189	.186	.184	.182	.180
+15	5.62	5.69	5.75	5.82	5.89	5.96	6.03	6.10	6.17	6.24
-15	.178	.176	.174	.172	.170	.168	.166	.164	.162	.160
+16	6.31	6.38	6.46	6.53	6.61	6.68	6.76	6.84	6.92	7.00
-16	.158	.157	.155	.153	.151	.150	.148	146	.144	.143
+17	7.08	7.16	7.24	7.33	7.41	7.50	7.59	7.67	7.76	7.85
-17	.141	.140	.138	.136	.135	133	132	130	.129	.127
+18	7.94	8.04	8.13	8.22	8.32	8.41	8.51	8.61	8.71	8.81
-18	.126	.124	.123	.122	.120	.119	117	.116	.115	114
+19	8.91	9.02	9.12	9.23	9.33	9.44	9.55	9.66	9.77	9.88
-19	.112	.111	.110	.108	.107	.106	105	.104	.102	.101
+20	10.0									
-20	.100									

Note: The sign of db is positive for ratios greater than one, and negative for ratios less than one.

POLARAD ELECTRONICS CORP.

CONSULTANTS — DESIGNERS — MANUFACTURERS

43-20 34th Street Long Island City 1, N. Y.

EXeter 2-4500

REQUEST FOR MAINTENANCE

FROM:

COMPANY NAME _____ DATE: _____

ADDRESS: _____ INDIVIDUAL _____

_____ POSITION _____

SECTION OR DIVISION _____ PHONE NO. _____ EXT. _____

EQUIPMENT _____ DATE OF PURCHASE _____

MODEL _____ SERIAL NO. _____ ORDER NO. _____

TROUBLE REPORT:

A. Description of trouble _____

_____

_____

_____

_____

_____

B. Has trouble been localized? _____ If so, how and where: _____

_____

_____

_____

_____

_____

C. Instruments used and measurements taken, if any: _____

_____

_____

_____

D. Is trouble intermittent? _____

E. Hours of operation prior to this trouble _____

F. Date trouble occurred _____

G. Was factory consulted by telephone or letter prior to this request? _____

If so, give date and person to whom directed: _____

_____

H. Additional Comments: _____

_____

_____

_____

_____

_____

_____

When trouble develops requiring factory assistance, complete this form and send to:

Polarad Electronics Corporation
43-20 34th Street
Long Island City 1, New York
ATTENTION: Service Department

After this report has been analyzed by the Service Department, you will be notified when a field service engineer will call on you to make the necessary repairs. If your trouble can best be corrected at the factory, we will so notify you with instructions and authorization for returning the equipment.

NO EQUIPMENT MAY BE RETURNED TO THE FACTORY WITHOUT WRITTEN AUTHORIZATION

THESE ARE POLARAD REPRESENTATIVES IN THE UNITED STATES AND THROUGHOUT THE WORLD

DOMESTIC REPRESENTATIVES

ARIZONA, CALIFORNIA, NEVADA

T. Louis Snitzer Company
5354 W. Pico Blvd.
Los Angeles, Calif.
Webster 8-2074

T. Louis Snitzer Company
7814 Ivanhoe Ave.
La Jolla, Calif.
Glencourt 4-2191

T. Louis Snitzer Company
510 S. Mathilda Avenue
Sunnyvale, Calif.
Regent 6-6733

ARKANSAS, LOUISIANA, OKLAHOMA, TEXAS, NEW MEXICO

Industrial Associated Electronics
5907 East Lancaster Ave.
Fort Worth, Texas
Jefferson 1-1132
Jefferson 5-2056

ILLINOIS, INDIANA, WISCONSIN

Loren F. Green & Associates
5218 West Diversey Avenue
Chicago, Illinois
Palisades 5-6824

OHIO, WESTERN PA., MICHIGAN

Harvey Teplitz & Co.
3543 Cornell Drive
Dayton 6, Ohio
Crestview 7-9178

Harvey Teplitz & Co.
671 Sycamore Drive
Cleveland, Ohio
Redwood 1-5676

Harvey Teplitz & Co.
19942 Inkster Road
Detroit 19, Michigan
Kenwood 7-9058

VIRGINIA, WASHINGTON, D.C., WEST VIRGINIA

Brimberg Associates
221 Investment Building
Washington 5, D.C.
Decatur 2-8000

ALABAMA, FLORIDA, GEORGIA, MISSISSIPPI, N. CAROLINA, S. CAROLINA, TENNESSEE

Murphy and Cota
2110 Peachtree Road, N.W.
Atlanta 5, Ga.
Trinity 3020

Murphy and Cota
1106 Burke Street
Winston-Salem, N.C.
Winston-Salem 4-0750

Murphy and Cota
1220 Edgewater Drive
Orlando, Fla.
Garden 4-2167

NEW ENGLAND

George Gregory Associates
99 Elm Street
West Newton, Mass.
Bigelow 4-4832

METROPOLITAN NEW YORK CITY

Home Office
Polarad Electronics Corporation
43-20 34th Street
Long Island City 1, N. Y.
EXeter 2-4500

Alfred A. Goldberg
Richard J. Sheloff

NEW YORK STATE (EXCEPT METROPOLITAN NEW YORK)

Northern Associates
704 Allen Road
North Syracuse, N. Y.
Glenview 8-2358

MARYLAND, SOUTH NEW JERSEY, EASTERN PENNSYLVANIA

Eastern Associates
1468 Old York Road
Abington, Pa.
TUrner 4-7200

Eastern Associates
5612 Belleville Ave.
Baltimore 7, Maryland
Liberty 2-1011

MISSOURI, KANSAS, IOWA, NEBRASKA

Engineering Services Co.
4550 Main Street
Kansas City 11, Mo.
Jefferson 1-7765

Engineering Services Co.
6635 Delmar Blvd.
St. Louis, Mo.
Volunteer 3-3661

Engineering Services Co.
4529 South Glenn
Wichita, Kansas
Jackson 4-0111
Jackson 4-8628

Engineering Services Co.
3742 Kencrest Drive, NE
Cedar Rapids, Iowa
EMpire 5-4538

COLORADO, UTAH, WYOMING, MONTANA

McLoud & Raymond
5403 East Evans
Denver 22, Colorado
Skyline 6-1580
Skyline 6-1589

OREGON, WASHINGTON, IDAHO

Hawthorne Electronics
700 S.E. Hawthorne Blvd.
Portland, Oregon
Belmont 4-9375

Hawthorne Electronics
Room 107 Administration Bldg.
Boeing Field
Seattle, Washington
Mohawk 3962

DOMINION OF CANADA

Measurement Engineering Ltd.
Arnprior, Ontario, Canada
Arnprior 400

Measurement Engineering Ltd.
P.O. Box 189
Station O
Montreal, Quebec, Canada

OVERSEAS REPRESENTATIVES

ALGERIA
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ARGENTINA
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Charcas 1337
Buenos Aires

AUSTRALIA
Electronic Industries
Imports Pty Ltd.
139/143 Bouverie St.
Carlton, N. 3, Melbourne

AUSTRIA
INGLOMARK
Markowitsch & Co.
Mariahilferstr 133
Vienna XV

BRAZIL
Emile H. Staub, S. A.
Rua Libero Badaro, 293
Sao Paulo

CHILE
Goldman, Janssen y Cia Ltda.
Casilla 274
Santiago

CHINA
Nan Jong Instruments Co.
69, Kaifeng Street
Taipei, Taiwan

CUBA
Cia Commercial Herza, S.A.
O'Reilly 504
Havana

DENMARK
Ditz Schweitzer
Bredgade 37
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ENGLAND
Allied International Co., Ltd.
59/61 Union Street
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GERMANY
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Auerfeldstr 22
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HAWAII
John J. Harding Co. Ltd.
P.O. Box 4013
Honolulu

HOLLAND
I. R. C. A.
92 Paradysstraat
Voorburg

INDIA
B. N. Bose & Company
1st Floor, 8 Waterloo St.
Calcutta—1

IRAQ
Shahine Medawar
P. O. Box 1679
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ISRAEL
Electronic Equipment
6, Ibn Gvirol
Tel-Aviv

ITALY
Henry C. Milano
Via C. Battisti 2
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JAPAN
Marubun Co. Ltd.
No. 1, 2-Chome,
Odenmacho, Nihonbashi
Chuo-Ku, Tokyo

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Calle Madrid 21-F
Mexico 4, D. F.

NEW ZEALAND
W & K McLean, Ltd.
7 Anzac Avenue
Auckland

NORWAY
Morgenstierne & Co.
Colletts Gate 10
Oslo

PERU
V. M. LaPierre & Cia.
Los Alamos 375
San Isidro, Lima

PORTUGAL
Equipamentos de
Laboratorio, Lda.
Apartado 458
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SAUDI ARABIA
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SOUTH AFRICA
Leigh & Hurwitz (Pty) Ltd.
P. O. Box 3236
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